PB85-103141

Effects of Pollution on Freshwater Organisms

(U.S.) Environmental Research Lab.-Duluth, MN

1984

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA *(Please read Instructions on the reverse before completing)*		
1. REPORT NO. EPA-600/J-84-101	2.	3. RI PB85-103141
4. TITLE AND SUBTITLE Effects of Pollution on Freshwater Organisms (Journal Version)		5. REPORT DATE 1984 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) G.L. Phipps, M.J. Harden, E.N. Leonard, T.H. Roush, D.L. Spehar, C.E. Stephan, Q.H. Pickering, A.L. Buikema		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Environmental Protection Agency Environmental Research Laboratory-Duluth 6201 Congdon Boulevard Duluth, Minnesota 55804		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development Environmental Research Laboratory U.S. Environmental Protection Agency Duluth, Minnesota 55804		13. TYPE OF REPORT AND PERIOD COVERED 14. SPONSORING AGENCY CODE EPA-600/03

15. SUPPLEMENTARY NOTES

J. Water Pollut. Control Fed. 56(6): 725-758 (1984)

16. ABSTRACT

The 1983 world literature on the effects of pollution on freshwater fish, amphibians, invertebrates and plants was reviewed. The effects of physical pollutants such as pH, and dissolved gases and organic and inorganic chemical pollutants are included. The review contains 625 references from reviews, symposia and journal articles.

17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release to public	Unclassified	36
	20. SECURITY CLASS *(This page)*	22. PRICE
	Unclassified	

NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

JWPCF, 56(6):725-758, June 1984

EPA-600/J-84-101
JOURNAL ARTICLE

Effects of pollution on freshwater organisms

Gary L. Phipps, Mary J. Harden,
Edward N. Leonard, Thomas H. Roush,
Diane L. Spehar, Charles E. Stephan,
Quentin H. Pickering, Arthur L. Buikema, Jr.

This review includes subjects in last year's reviews on "Effects of pollution on freshwater invertebrates" and "Effects of pollution on freshwater fish and amphibians." This review also includes information on the effects of pollution on freshwater plants.

Pollutant Type of Information
Acenaphthene
96-hr LC50[a] = 608 μg/L and NOEC[b] = 413 μg/L for fathead minnow (*Pimephales promelas*)[1]
Affected growth of *Anabaena flos-aquae*[2]
96-hr LC50s for five species = 580 to >2 040 μg/L[3]
Acetone
Increased toxicity of Fennosan to brown trout (*Salmo trutta*) and rainbow trout (*Salmo gairdneri*)[4]
Susceptibilities of 22 species from bacteria through amphibians = 72-24 000 mg/L[5]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Acetone (Continued)
No affect on acute toxicity of seven pesticides to *Oryzias latipes*[6]
48-hr LC50s for 15 macroinvertebrates = 5 000–15 000 mg/L[7]
Acute toxicity to six species[8]
48-hr LC50 for *Daphnia magna* = 39 000 μL/L; MATC[c] = 1 400–2 800 μL/L[9]
96-hr LC50 for fathead minnow = 7 280–8 140 mg/L[10,11]
Acetonitrile
48-hr LC50 for *Oryzias latipes* = >1 000 mg/L[12]
Acetophenone
96-hr LC50 for fathead minnow = 160 mg/L[10,11]
Acrylamide
50 μg/L decreased species diversity in a river[13]
Acrylonitrile
48-hr LC50 for *Oryzias latipes* = 32 mg/L[12]
Afalon Special
48-hr LC50 = 36–86.7 mg/L for three fishes[14]
Aflatoxin
2.5 mg/kg in feed damaged liver of *Oryzias latipes*[15]
Alachlor
EC50[d] = 350 μg/L for *Chlamydomonas reinhardii*[16]
Field verification of bioaccumulation model[17]
Alcohol ether sulfate
96-hr LC50s = 1.0–3.1 mg/L for four fishes[18]
Alcohol ethoxylate
96-hr LC50s = 0.6–2.8 mg/L for four fishes[18]
48-hr LC50 for *Daphnia magna* = 0.62 mg/L[19]
Aldicarb (Temik)
96-hr LC50 = 1 370 μg/L; MATC = 78–156 μg/L for fathead minnow[20]
Aldrin
Physiological effects on two fishes[21]
Concentrations in various fishes[22,23,25,29,31,34]
Hematological effects on *Clarias batrachus*[24]
96-hr LC50 = 0.04331 mg/L for *Ranatra elongata*[28]
BCF[e] = 13 390 with *Corbicula manilensis*[30]
Uptake from wastewater by two fishes[32]
Effects on bluegill (*Lepomis macrochirus*) ATPases[33]
Allylamine
Susceptibilities of 22 species from bacteria through amphibians = 0.35–3 140 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 5–>180 mg/L[7]
Acute toxicity to six species[8]
Aluminum
Reduced survival and growth of brook trout (*Salvelinus fontinalis*) and white sucker (*Catostomus commersoni*)[37]
Toxicity to *Daphnia middendorffiana*[38]
Toxicity to *Chlorella pyrenoidosa* at pH = 4.9–7.1[39]
Effect of calcium and pH on toxicity to various ages of young brown trout[40]
Effects on respiration and activity of rainbow trout[41]
Joint effects with low pH caused fish kill[42]

Pollutant Type of Information
Aluminum (Continued)
Toxicity to 32 bacteria and *Daphnia magna*[43]
Concentrations in six Canadian species[44]
Concentrations in rainbow trout and plankton after lake treatment[45]
Aminex
Effect on *Chorella vulgaris*[46]
Aminoazotoluene
0.05 mg/kg in feed damaged liver of *Oryzias latipes*[15]
Aminocarb (Matacil)
Toxicity to two algae and *Daphnia magna*[47]
Possible effects on pond algal communities[48]
Aminodinitrotoluenes
Acute toxicity = 0.9–15 mg/L for *Daphnia magna* and fathead minnow[49]
Aminonitrotoluenes
Acute toxicity = 7–69 mg/L for *Daphnia magna* and fathead minnow[49]
96-hr LC50 = 0.9–87 mg/L for fathead minnow[50]
Ammonia
96-hr LC50 = 0.74–3.15 mg/L for five species[51]
Site-specific environmental assessments[52]
With chlorine, suppressed fish in two Illinois streams[54]
Avoidance tests with three carps[55]
Hematological effects on three species[56]
Biochemical effects on *Channa punctatus*[57]
Joint effects with cyanide and low DO[58]
Influenced motility behavior of rainbow trout[59]
Does not cause gill hyperplasia in channel catfish (*Ictalurus punctatus*) unless chlorine is present[60]
Effects on growth and survival of rainbow trout[61]
96-hr LC50 = 0.16–1.1 mg/L for rainbow trout depending on age and temperature[62]
96-hr LC50 = 0.75–3.4 mg/L for fathead minnow depending on temperature[63]
96-hr LC50 for guppy (*Poecilia reticulata* = *Lebistes reticulatus*) = 7.2 mg/L[64]
Toxicity to *Elodes densa*[65]
Discussion of water quality criteria[66,67]
96-hr LC50 = 0.59–1.54 mg/L for eight fishes; toxicity increased as DO decreased; growth of larvae of fathead minnows and channel catfish was reduced at 0.11–0.28 mg/L[68]
Reduced oxygen consumption of *Corbicula regularis*[69]
Aniline
Susceptibilities of 22 species from bacterial through amphibians = 0.07–800 mg/L[5]
4-hr LC50s for 15 macroinvertebrates = 64–760 mg/L[7]
Acute toxicity to six species[8]
48-hr LC50 for *Oryzias latipes* = 48 mg/L[12]
Avoidance tests with three carps[55]
96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]
Anisoles
Toxicity to two green algae[71]
Review of effects on fishes[72]
Anthracene
48-hr LC50 = 17 mmol/m^3 for *Daphnia magna*[73]
Caused death of bluegills in sunlight, but not shade[74]

Table 1—(Continued)

Pollutant Type of Information
Anthracene (Continued)
Uptake by *Daphnia magna* is much greater from water than from food[75]
Uptake and depuration by bluegill[76]
Bioconcentration by *Chironomus riparius*[77]
Periodic depuration by rainbow trout[78]
Antimony
Relationship of feeding habits to concentrations in insects[79]
Relationship of size to concentrations in insects[80]
Antimycin
With rotenone, impacted lake zooplankton[81]
Toxicity to fathead minnow reduced by bentonite[82]
Presumed harmless concentration for a snail = 73 ng/L[83]
Arsenic
Concentrations in various fishes[29,84]
Uptake from wastewater by two fishes[32]
Uptake by plants[85]
Concentrations in aquatic organisms from a polluted stream[86]
Concentrations in *Pacifastacus trowbridgi*[87]
Concentrations in Great Lakes biota[88]
Arsenic (III)
48-hr LC50 = 97 mg/L for *Tanytarsus dissimilis* and 24.5 mg/L for *Aplexa hypnorum*[3]
Avoidance tests with three carps[55]
Toxicity to *Elodes densa*[65]
Uptake by *Chlorella kessleri*[90]
Decreased growth of *Colisa fasciatus* fingerlings[91]
Uptake by 20 algae[92]
Arsenic (V)
Uptake by *Chlorella kessleri*[90]
Uptake by 20 algae[92]
Uptake by five bacteria[93]
50 mmol/L killed *Poterioochromonas malhamensis*[94]
Toxicity of a mixture to four algae[95]
Cellular location in green sunfish (*Lepomis cyanellus*)[96]
Arsenic, organo
Uptake by *Chlorella kessleri*[90]
0.4 mol/L killed *Poterioochromonas malhamensis*[94]
Uptake and depuration by guppy[97]
Asbestos
Caused lesions in kidneys and gills of Amazon molly (*Poecilia formosa*)[98]
Atrazine
Field verification of bioaccumulation model[17]
Caused changes in a pond ecosystem[99]
Effects on plankton in treated ponds[100]
Physiological effects on *Lemna minor*[101]
10 µg/L decreased phytoplankton diversity[102]
Toxicity to common carp (*Cyprinus carpio*)[103]
Azide
Physiological effects on *Chlamydomonas reinhardtii*[105]
Barium
Concentrations in six Canadian species[44]
Concentrations in English mosses[106]
Concentrations in *Rhynchostegium riparioides*[107]

Pollutant Type of Information
Basagran
96-hr LC50 for mosquitofish (*Gambusia affinis*) = 3 874 mg/L[108]
Bayer 73 (lampricide)
Presumed harmless concentration for a snail = 1.34 µg/L[83]
Uptake and depuration by four fishes[109]
Befenox
Toxicity to 14 species[110]
Benthiazol
Acute toxicity to two amphibians[36]
Bentonite
Reduced toxicity of five chemicals to fathead minnow[82]
Benzanthracene
Affected growth of *Anabaena flos-aquae*[2]
Benzene
Susceptibilities of 22 species from bacteria through amphibians = 24->1 400 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 34->320 mg/L[7]
Acute toxicity to six species[8]
48-hr LC50 = 400 mmol/m^3 for *Daphnia magna*[73]
96-hr LC50 = 15 mg/L for *Daphnia pulex*; uptake and depuration[111]
Toxicity thresholds = 5 010 mmol/m^3 for two protozoa[112]
96-hr LC50 for rainbow trout = 5.3 mg/L[113]
96-hr LC50 = 8.25 mg/L for rainbow trout[114]
Benzidine
48-hr LC50 for *Oryzias latipes* = 10.5 mg/L[12]
Benzo(a)anthracene
96-hr LC50 for *Daphnia pulex* = 10 µg/L; uptake and depuration[111]
Benzo(a)pyrene
Uptake by *Daphnia magna* is much greater from water than from food[75]
Uptake and depuration by bluegill[76]
96-hr LC50 for *Daphnia pulex* = 5 µg/L; uptake and depuration[111]
Morphological abnormalities in rainbow trout alevins[115]
Effects on neurotransmitters in channel catfish[116]
Induced mixed function oxidase in channel catfish[117]
Benzoate
10 g/L in feed damaged liver of *Oryzias latipes*[15]
Benzoepin
Acute toxicity to *Oryzias latipes*[8]
Benzoic acid
0.5 mg/L did not affect growth of *Anabaena flos-aquae*[118]
Benzophenone
96-hr LC50 for fathead minnow = 14.2–15 mg/L[10,11]
n-Benzylbutanamides
Structure-activity relationship for inhibition of bulrush growth[119]
Beryllium
Concentrations in Mississippi fishes and *Elliptio dilatata*[29,44]
Bicarbonate
Reduces adverse effects of fish hauling[592]
Biphenyl
48-hr LC50 = 20 mmol/m^3 for *Daphnia magna*[73]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Biphenyl (Continued)
Toxicity thresholds for two protozoa were above solubility[112]
Acute toxicity = 1.5–4.7 mg/L for three species[121]
Bisulfite
More toxic to *Ankistrodesmus* sp. at pH 5 than 7[122]
Boron
Concentrations in six Canadian species[44]
Bromide
Uptake and depuration by fathead minnow[123]
1-Bromo-3-chloro-5,5-dimethylhydantoin
96-hr LC50 = 1.2–1.8 mg/L for fathead minnow and 2.35 mg/L for bluegill[124]
Bromocyclohexane
Acute and chronic toxicity to three species[125]
4-Bromophenol
Effect of pH on acute toxicity and bioconcentration with guppy[126]
Butachlor
EC50 = 40 μg/L for *Chlamydomonas reinhardii*[16]
Acute toxicity to two amphibians[36]
1-Butanol
96-hr LC50 = 1 700 mg/L for fathead minnow[10,11]
2-Butanone
96-hr LC50 = 3 200 mg/L for fathead minnow[10,11]
Butylamine
96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]
Cadmium
96-hr LC50 for brook trout = 5 080 μg/L[3]
Susceptibilities of 22 species from bacteria through amphibians = 0.025–115 mg/L[5]
48-hr LC50 for 15 macroinvertebrates = 0.08–>56 mg/L[7]
Acute toxicity to six species[8]
Concentrations in various fishes[29,133,144,150,153]
Uptake from wastewater by two fishes[32]
Concentrations in six Canadian species[44]
Avoidance tests with three carps[55]
Toxicity to *Elodes densa*[65]
Concentrations in *Pacifastacus trowbridgi*[87]
Uptake by *Chlorella kessleri*[90]
Uptake by 20 algae[92]
Toxicity of a mixture to four algae[95]
Concentrations in European mosses[106,147]
Concentrations in *Rhynchostegium riparioides* in England[107]
Concentrations in snapping turtles[129]
Effect of various chlorides on toxicity and uptake[130]
Uptake by bacterial cultures[131]
Toxicity to and uptake by two algae[132]
96-hr LC50 = 25 mg/L for *Danio malabaricus* and 32 mg/l for *Punctius ticto*[134]
Biochemical effects on *Puntius conchonius*[135]
Biochemical effects on *Heteropneustes fossilis*[136]
Bound by protein in three fishes[137]
Reduced phytoplankton productivity and abundance[138]

Pollutant Type of Information
Cadmium (Continued)
Toxicity to 87 species of Chlorophyta[139]
BCF = 3 770–1 752 with *Corbicula fluminea*[140]
Concentrations in European *Fontinalis antipyretica*[141]
Concentrations in English invertebrates[142]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Biochemical effects on *Heteropneustes fossilis*[145]
Uptake and effect on growth of *Hydro littoralis*[146]
Pulses at LC50 for chronic periods produced no effect on *Daphnia magna*[148]
LC50 for *Chlorella pyrenoidosa* = 2.1 mg/L[149]
Toxicity to a diatom was decreased by EDTA and iron (III)[151]
Effect of water quality on toxicity to *Selenastrum capricornutum*[152]
Toxicity to fungi decreased by chloride[154]
Reduced stream flora[155]
Effect of selenium on toxicity to a snail and an alga[156]
Uptake and depuration by common carp[157]
Effects on three aquatic angiosperms[158]
Reduced photosynthesis in water moss[159]
Effect of pH on toxicity to bacteria[160]
Cytochemical effects on common carp[161]
Uptake by stream insects in field study[162]
96-hr EC50 = 3 mg/L for diatom *Navicula incerta*[163]
Toxicity to early life stages of fishes[164]
Uptake in liver and kidney of *Channa punctatus*[165]
Uptake by *Moina macrocopa*[166]
4-hr EC50 = 50 mg/L for *Nitrobacter* and *Nitrosomonas*[167]
Concentrations in river otters[168]
Possibly differentially affected caddisflies[169]
Review of effects on aquatic life[170]
Calibration of energy and material model[171]
Fathead minnow developed and lost increased tolerance[172]
Effect of other metals on 96-hr LC50 for white sucker[173]
Effect of NH_3, EDTA, and pH on uptake by and effect of growth of *Lemna paucicostata*[174]
96-hr EC50 for *Chlorella saccharophila* = 0.11 mg/L[175]
Decreased ATP in *Procambarus acutas*[176]
96-hr LC50 for *Lymnaea acuminata* = 0.872 mg/L[177]
Impaired hatch of common carp[178]
Toxicity to rainbow trout embryos and larvae[179]
Chronic toxicity to and uptake by fathead minnow[180]
Humus reduces toxicity to and uptake by *Selenastrum capricornutum*[181]
Physiological effects on rainbrow trout cell cultures[182]
Induced cadmium-binding protein in threespine stickleback (*Gasterosteus aculeatus*)[183]
2 μg/L killed Atlantic salmon (*Salmo salar*) alevins and fry[184]
Induced metallothionein in fish[185]
Uptake by *Oryzias latipes*[186]
Effect on osmoregulation in channel catfish[187]
Toxicity to various life stages of *Oryzias latipes* and *Tilapia zilli*[188]
Toxicity to *Oryzias latipes* reduced by preexposure to selenium (IV) and cadmium[189]
Concentrations in German *Gammarus tigrinus*[190]
Uptake by liverwort[191]
Uptake by *Chlorella vulgaris*[192]
Uptake by rainbow trout[193]
96-hr LC50 = 19.7 mg/L for *Channa punctatus*[194]
Induced metallothioneins in goldfish (*Carassius auratus*)[195]
Depuration and effects on fathead minnow after 96-hr exposure[196]
96-hr LC50 for *Ranatra elongata* = 0.29 mg/L[629]

Table 1—(Continued)

Pollutant Type of Information
Caffeine
Mutagenic effects on goldfish cells[197]
A potential fish fungicide[198]
Calcium
Concentrations in six Canadian species[44]
Concentrations in European mosses[147]
Physiological effects on *Rana catesbeiana* and *R. nigromaculata*[199]
Caparol (Prometryn)
Adaptation by carp[200]
Captafol (Difolatan)
Acute toxicity to *Oryzias latipes*[6]
Captan
Acute toxicity to *Oryzias latipes*[6]
Carbaryl (Sevin)
96-hr LC50 = 0.624 mg/L for *Ranatra elongata*[28]
Effects on bluegill ATPases[33]
Avoidance tests with three carps[55]
96-hr LC50 = 4.4 mg/L for *Lymnaea acuminata*; effects of synergists[201]
96-hr LC50 for bullfrog tadpole = 6.2 mg/L; 2 mg/L caused death during metamorphosis[202]
48-hr LC50 for Mozambique tilapia (*Tilapia mossambica*) = 5.495 mg/L[203]
Biochemical effects on *Channa punctatus*[204]
Chronic effects on *Lymnaea stagnalis*[205]
Did not reduce RNA-DNA ratios in two salmonids[206]
Carbendazim
Toxicity to early life stages of common carp and trout[207]
Carbofuran (Furadan)
Biochemical effects on four species[33,208-211]
Acute toxicity to five species[212]
Carbon dioxide
Influenced motility behavior of rainbow trout[59]
Carbon tetrachloride
96-hr LC50 = 1.97 mg/L for rainbow trout and 4.00 mg/L for fathead minnow[114]
Food chain dynamics in Finnish lakes[213]
Carboxin
LC50 = 887.5 mg/kg for Mozambique tilapia[214]
96-hr LC100 for Mozambique tilapia = 12.59 mg/L[215]
Carboxymethyloxysuccinate (CMOS)
96-hr LC50s = 1.5–3.5 g/L for four fishes[18]
Cartap (Padan)
Avoidance tests with three carps[55]
Catechol (1,2-Dihydroxybenzene)
Toxicity to two plants[216]
Cesium
Uptake by *Phoxinus phoxinus* and *Lota lota*[220]
Uptake by two fishes in a lake[221]
Chlomethoxynil
Acute toxicity to two amphibians[36]
Concentrations in Japanese fishes[607]

Pollutant Type of Information
Chlordane
LC50 = 1.25 mg/L for *Aplex hypnorum* and 1.4 mg/L for *Tanytarsus dissimilis*[3]
Concentrations in various fishes[22,31,34,222,223]
BCF with *Corbicula manilensis* = 4 330–4 810[30]
Effects on bluegill ATPases[33]
Chloride
Decreased cadmium toxicity to fungi[154]
Physiological effects on striped bass (*Morone saxatilis*)[224]
Joint effect with nitrite on methemoglobin in channel catfish[225]
Reduces adverse effects of fish hauling[592]
Chlorine
96-hr LC50 = 0.17–1.6 mg/L for various fishes[51,124]
With ammonia, suppressed fish in two Illinois streams[54]
Necessary for "ammonia" to cause gill hyperplasia in channel catfish[60]
Hazard assessments of point-source discharges[226]
Effect of acute toxicity and bioconcentration of nickel by rainbow trout[227]
Effects on stream aufwuchs[228]
Hematological effects on bluegill[229]
Review of data on toxicity to aquatic animals[230]
Toxicity to fathead minnow and bluegill[231]
Chlornitrophen (CNP)
Metabolites in three Japanese species[126]
24-hr LC50 for common carp = 0.18 mg/L[234]
Concentrations in Japanese fishes[607]
4-Chloroaniline
Concentrations in biota in treated ponds[233]
Chlorobenzene
96-hr LC50 = 0.11 mg/L for rainbow trout[114]
Toxicity to various species[310]
4-Chlorobiphenyl
48-hr LC50 = <3 mmol/m^3 for *Daphnia magna*[73]
Chloroform
96-hr LC50 = 2.09 mg/L for rainbow trout and >58 mg/L for fathead minnow[114]
1 µL/L reduced 60-day survival and growth of *Poecilia sphenops*[232]
Chloronaphthalenes
48-hr LC50 = <5–23 mmol/m^3 for *Daphnia magna*[73]
Chloroneb
Acute toxicity to two amphibians[36]
Chlorophenols
Review of effects on fish[72]
Effect of pH on acute toxicity and bioconcentration with guppy[126]
Uptake and metabolism by 12 fishes[235]
Chlorpyrifos (Dursban)
MATC for fathead minnow = <0.12 µg/L; BCF = 1 700[236]
96-hr LC50 = 203 µg/L for fathead minnow and 8 µg/L for rainbow trout[331]
Chromium
Concentrations in Mississippi fishes[29]
Relationship of feeding habits to concentrations in insects[79]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Chromium (Continued)
Relationship of size to concentrations in insects[80]
Concentrations in *Rhynchostegium riparioides* in England[107]
None found in Japanese fishes[133]
Concentrations in Canadian *Sphagnum magellanicum*[143]
0.1 mg/L reduced respiration in *Chironomus tentans*[237]
Chromium (III)
Toxicity to *Elodes densa*[65]
Uptake by *Chlorella kessleri*[90]
Effect of ligands on uptake and depuration with guppy[97]
Chromium (VI)
Avoidance tests with three carps[55]
Toxicity to *Elodes densa*[65]
Uptake by *Chlorella kessleri*[90]
Toxicity of a mixture to four algae[95]
96-hr LC50 for *Lymnaea acuminata*[177]
96-hr LC50 = 45.2 mg/L for *Channa punctatus*[194]
Effect of pH on chronic toxicity to rainbow trout[238]
Biochemical effects on *Channa punctatus*[239]
10 mg/L caused gill damage in rainbow trout[240]
Acute toxicity to several fishes[241]
Physiological effects on *Euglena gracilis*[242]
Toxicity to *Daphnia magna*[243]
96-hr LC50 = 1.84 mg/L for *Macrobrachium lamarrei*[244]
Chrysene
Affected growth of *Anabaena flos-aquae*[2]
Cineol
Toxicity to carp and *Daphnia magna*[245]
Coal liquid
Decreased survival, growth, reproduction, and productivity of four species[246]
Acute toxicity to various species[247-249]
Chronic toxicity to fathead minnow and rainbow trout[250]
EC50 = 1.05–6.92% for seven algae[251]
Cobalt
Concentrations in six Canadian species[44]
Relationship of feeding habits to concentrations in insects[79]
Relationship of size to concentrations in insects[80]
Concentrations in *Rhynchostegium riparioides*[107]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Concentrations in European mosses[147]
Impaired hatch of common carp[178]
Uptake by *Phoxinus phoxinus*[220]
Uptake by two fishes in a lake[221]
Congo Red
48-hr LC50 for *Oryzias latipes* = >1 000 mg/L[12]
Biochemical changes in *Heteropneustes fossilis*[252]
Copper
48-h LC50 for *Daphnia magna* = 0.026 mg/L[19]
Concentrations in various fishes[29,133,144]
Uptake from wastewater by two fishes[32]
Concentrations in six Canadian species[44]
Avoidance tests with three carps[55]
Toxicity to *Elodes densa*[65]
Reduced oxygen consumption of *Corbicula regularis*[69]
Concentrations in *Pacifastacus trowbridgi*[87]

Pollutant Type of Information
Copper (Continued)
Concentrations in Great Lakes biota[88]
Uptake by 20 algae[92]
Toxicity of a mixture to four algae[95]
Concentrations in *Rhynchostegium riparioides*[107]
24-hr LC50 = 0.5 mg/L for *Danio malabaricus* and 3.0 mg/l for *Puntius ticto*[134]
Toxicity to 87 species of Chlorophyta[139]
BCF = 22 571–17 720 with *Corbicula fluminea*[140]
Concentrations in European *Fontinalis antipyretica*[141]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Concentrations in European mosses[147]
Pulses at LC50 for chronic test reduced survival, growth, and reproduction of *Daphnia magna*[148]
Uptake and depuration by common carp[157]
Effects on three aquatic angiosperms[158]
Reduced photosynthesis in water moss[159]
96-hr EC50 = 10 mg/L for diatom *Navicular incerta*[163]
4-hr EC50 = 20–50 mg/L for *Nitrobacter* and *Nitrosomonas*[167]
Concentrations in river otters[168]
Possibly differentially affected caddisflies[169]
Fathead minnows developed and lost increased tolerance[172]
Effect of NH_3, EDTA, and pH on uptake by and effect on growth of *Lemna paucicostata*[174]
96-hr EC50 for *Chlorella saccharophila* = 0.55 mg/L[175]
96-hr LC50 for *Lymnaea acuminata* = 0.034 mg/L[177]
Impaired hatch of common carp[178]
Toxicity to rainbow trout embryos and larvae[179]
Effects on stream aufwuchs[228]
Effects of complexing agents on toxicity to *Daphnia magna* and guppy[253]
With zinc, effect on *Scenedesmus quadricauda*[254]
Effects of EDTA on depuration by common carp[255]
Toxicity to river algal communities[256]
Effect on standing crop and photosynthesis of phytoplankton and *Chlorella vulgaris*[257]
Biochemical changes in the snail *Lymnaea luteola*[258]
Uptake by sludge bacteria[259]
5 µg/L caused cytological changes in algae[260]
Concentrations in macrophytes[261]
Effects on microbial communities[262]
Concentrations in Irish *Sphagnum*[263]
Concentrations in *Oziotelphusa senex*[264]
Effect of EDTA and NTA on toxicity to *Selanastrum capricornutum*[265]
Toxicity to green algae[266]
Reviewed effects on aquatic life[267]
Probably inhibited growth of algae in Lake Kinneret[268]
Biochemical effects on common carp[269]
96-hr LC50 for *Gammarus pulex* = 17–96 µg/L; delayed mortality[270]
Sewage treatment plant effluent reduced toxicity to coho salmon (*Oncorhynchus kisutch*)[626]
Creosote
Acute and chronic toxicity to *Daphnia pulex*[272]
Cresols
Susceptibilities of 22 species from bacteria through amphibians = 2.9–160 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 10–165 mg/L[7]
Acute toxicity to six species[8]

Table 1—(Continued)

Pollutant
Type of Information

Cresols (Continued)
- Uptake and metabolism by 12 fishes[236]
- 8 mg/L reduced photosynthetic rate of *Spirogyra*[271]

Cumene
- 48-hr LC50 = 5 mmol/m^3 for *Daphnia magna*[73]

Cutrine
- 96-hr LC50 = 170 µg/L for mosquitofish[108]

Cyanide
- Concentrations in Mississippi fishes[29]
- Joint effects with ammonia and low DO[58]
- Toxicity to *Elodes densa*[65]
- Reduced oxygen consumption of *Corbicula regularis*[89]
- Physiological effects on *Chlamydomonas reinhardtii*[105]
- Oxidation with hypochlorite did not substantially reduce toxicity of an effluent to Atlantic salmon[273]
- Review of effects on aquatic life[274]
- Effect of complexation on toxicity to two species[275]
- Acclimation temperature affected 96-hr LC50 for rainbow trout[276]
- Correlation between concentrations in fish and toxicity[277]
- 0.005–0.045 mg/L reduced growth of rainbow trout[278]

Cyclohexane
- 48-hr LC50 = 45 mmol/m^3 for *Daphnia magna*[73]
- Toxicity thresholds = 288–588 mmol/m^3 for two protozoa[112]

Cyclohexanol
- 96-hr LC50 = 700 mg/L for fathead minnow[10,11]

Cychlohexanone
- 96-hr LC50 = 527–732 mg/L for fathead minnow[10,11]

Cyclohexene
- Acute and chronic toxicity to three species[125]

Cyclohexylamine
- 96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]

Cyclopentane
- 48-hr LC50 = 150 mmol/m^3 for *Daphnia magna*[73]

Cyclopropenoid fatty acids
- Biochemical effects on rainbow trout[279]

Cymenes, chloro-
- Food chain dynamics in Finnish lakes[213]

2,4-D (Fernoxone)
- Concentrations in Texas fish[34]
- 10 mg/L increased blue green algae[102]
- Correlation between concentrations in fish and toxicity[277]
- Effects on *Punctius ticto*[280]
- 250 mg/L reduced heart beat rate of *Daphnia magna*[281]
- Stimulated microbial communities in three ponds[282]
- Factors affecting bioavailability to plants and animals[283]
- Rapidly excreted in urine of rainbow trout[284]

DDD, DDE, and DDT
- Concentrations in various fishes[22,23,25,29,31,34,150,223,266,268,294]
- Uptake from wastewater by two fishes[32]
- Biochemical effects on various fishes[33,291,293,295,296]
- Neurophysiological effects on *Procambarus clarki*[35]
- Concentrations in Great Lakes biota[89]
- Food chain dynamics in Finnish lakes[213]

Pollutant
Type of Information

DDD, DDE, and DDT (Continued)
- Effects on cortisol in *Sarotherodon aureus*[286]
- Accumulation and metabolism by *Tetrahymena pyriformis*[287]
- Concentrations in Israeli aquatic life[289]
- Uptake and depuration by *Channa striatus*[292]
- Uptake by three plants[297]
- BCF for *Lemna minor* = 1 410[298]
- Concentrations in 18 Chinese species[299]
- 24-hr LC50 = 48 µg/L for *Macrobrachium kistensis*[300]

DEF (S,S,S-Tributylphosphorotrithioate)
- 96-hr LC50 for rainbow trout = 0.31 mg/L; delayed mortality[301]

Decane
- 48-hr LC50 = 0.2 mmol/m^3 for *Daphnia magna*[73]
- Toxicity thresholds for two protozoa were above solubility[112]

1-Decanol
- 96-hr LC50 = 2 mg/L for fathead minnow[10,11]

Dehydroabietic acid
- Effect of pH on LC50 for three species[302]

Detergents (see also LAS, sodium dodecyl sulfate, and surfactants)
- Physiological effects on two fishes[21]
- Hematological effects on *Clarias batrachus*[24]
- Acute toxicity to carp and *Daphnia pulex*[304]
- 60–100 mg/L reduced growth of an alga[305]
- Toxicity to *Daphnia, Paramecium* and goldfish[306]

Dextrose
- Effects on stream aufwuchs[228]

Diazinon
- Biochemical effects on two fishes[33,308]
- Concentrations in Texas fish[34]
- Acute toxicity to two amphibians[36]
- LC50 = 50.0–625.0 mg/kg for Mozambique tilapia[214]
- 96-hr LC100 for Mozambique tilapia = 15.85 mg/L[215]
- 24-hr LC50 for common carp = 1.9 mg/L[234]
- Photodegradation increased toxicity to fish[307]

Dibenzofurans, polychlorinated
- Concentrations in Great Lakes fishes[309]

Dibutylamine
- 96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]

Dichlorobenzenes
- 96-hr LC50 = 4.0–7.8 mg/L for fathead minnow[10,11]
- 48-hr LC50 = <44 mmol/m^3 for *Daphnia magna*[73]
- 96-hr LC50 = 3.01 mg/L for rainbow trout[114]
- Toxicity to various species[310]
- Toxicity to and uptake by early life stages of rainbow trout[311]

4,5-Dichlorocatechol
- Toxicity to two plants[216]

Dichloroethanes
- 96-hr LC50 = 118 mg/L for fathead minnow[10,11]
- 96-hr LC50 = 34 mg/L for rainbow trout[114]

4,5-Dichloroguaiacol
- Toxicity to two plants[216]

Dichlorophenols
- Effect of pH on acute toxicity and bioconcentration with guppy[126]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Dichlorophenols (Continued)
Toxicity to two plants[218]
96-hr LC50 = 1.0–1.9 mg/L for *Notopterus notopterus*; effects of size and other phenols[312]
Dichlorvos (DDVP)
Photodegradation increased toxicity to fish[307]
Biochemical effects on *Mystus vittatus*[209]
30-day biochemical effects on three fish species[313]
Dieldrin
Field verification of bioaccumulation model[17]
Concentrations in various fishes[22,25,29,31,34,294]
BCF = 3 540 with *Corbicula manilensis*[30]
Uptake from wastewater by two fishes[32]
Effects on bluegill ATPases[33]
Concentrations in Great Lakes biota[88]
Concentration in amphipods[314]
Effects on 16 aquatic communities[315]
Effects on microcosms[316]
Diethylamine
96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]
Diethylpropion
2 mg/L reduced food intake by *Haplochromis burtoni*[317]
Diflubenzuron (Dimilin)
Chronic toxicity to *Daphnia magna*
Toxicity to several species and a stream community[319]
2-(Digeranylamino)-ethanol
Not effective for control of common carp in ponds[320]
Diisopropylamine
96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]
Diisopropyl ether
96-hr LC50 = 91.7 mg/L for fathead minnow[10,11]
Dimethametryn
Acute toxicity to two amphibians[36]
Dimethoate
LC50 = 1 500 mg/kg for Mozambique tilapia[214]
Biochemical effects on *Heteropneustes fossilis*[321]
Dimethylamine
96-hr tests with alga, *Daphnia magna*, and rainbow trout[70]
Dimethylaminoaniline
Effects on toxicity of four pesticides to a snail[201]
3,5-Dimethylbenzoic acid
0.5 mg/L did not affect growth of *Anabaena flos-aquae*[118]
Dimethylformamide
48-hr LC50 for *Daphnia magna* = 13 mL/L; MATC = 1.2–2.5 mL/L[9]
NOEC = 0.5 mL/L for *Selenastrum capricornutum*[322]
48-hr EC50 = 4.5–15.3 g/L for *Daphnia magna*[323]
Dimethyl sulfoxide (DMSO)
No affect on acute toxicity of seven pesticides to *Oryzias latipes*[6]
Dinitrobenzenes
Acute toxicity = 1.3–50 mg/L for *Daphnia magna* and fathead minnow[49]
Dinitrophenols
96-hr LC50 for guppy[126]
Biochemical effects on *Notopterus notopterus*; mixtures with other phenols[324–326]
Effect of temperature, phenol, and pentachlorophenol on LC50 for *Notopterus notopterus*[327,328]
2,4-Dinitrotoluene
Acute toxicity = 33–48 mg/L for *Daphnia magna* and fathead minnow;
BCF = 4–2 507 with four species[49]
Diphenyl ether
96-hr LC50 = 4.0 mg/L for fathead minnow[10,11]
Diquat
96-hr LC50 for mosquitofish = 289 mg/L[108]
Toxicity to algae[329]
Diram
Acute toxicity to *Oryzias latipes*[6]
Disulfoton
96-hr LC50 for fathead minnow and rainbow trout = 4 000 and 3 020 µg/L[331]
Diuron
10 µg/L decreased phytoplankton diversity[102]
1-Dodecanol
96-hr LC50 = 1.01 mg/L for fathead minnow[10,11]
Dodecylbenzene
BCF = 14–1 250 with bluegill[332]
Dodecylcyclohexane
Effects on rainbow trout lipids[333]
EDTA
Reduced toxicity of cadmium to a diatom[151]
Increased depuration of copper and cadmium[157]
EPN
Acute toxicity to *Oryzias latipes*[6]
Biochemical effects on live and dead fish[334]
Edifenphos (EDDP)
Photodegradation increased toxicity to fish[307]
Electroplating waste
Acute toxicity to 12 fishes[335]
Endosulfan
96-hr LC50 for *Aplexa hypnorum* = >1 890 µg/L[3]
4-hr EC50 = 20 mg/L for Nitrobacter and >10 mg/L for Nitrosomonas[167]
24-hr LC50 for common carp = 0.0015 mg/L[234]
48-hr EC50s for *Daphnia magna* = 158–740 µg/L[336]
Hematological effects on *Clarias batrachus*[337]
LC50 = 4.3 µg/L for *Barbus stigma*; sublethal effects[338]
Metabolic effects on *Channa punctatus*[339]
LC50s = 0.3–343 µg/L for three species[340]
Endothal
No effect on tolerance of red shiner (*Notropis lutrensis*) to temperature[341]

Table 1—(Continued)

Pollutant Type of Information
Endothall (Continued)
14-day LC50 = 62.5 mg/L for chinook salmon (*Oncorhynchus tshawytscha*); histological effects[342]
Endrin
Concentrations in various fishes[22,29,34]
Uptake from wastewater by two fishes[32]
Effects on bluegill ATPases[33]
Chronic toxicity to and uptake by fathead minnow[180]
Uptake by three plants[257]
9,10-Epoxystearic acid
Toxicity to two plants[216]
Ethalfluralin
Factors affecting bioavailability to plants and animals[283]
BCF = 235 with *Lemna minor*[298]
Ethanol
96-hr LC50 = 14 200–15 400 mg/L for fathead minnow[10,11]
Ethyl acetate
Susceptibilities of 22 species from bacteria through amphibians = 15–3 950 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 130–3 020 mg/L[7]
Acute toxicity to six species[8]
Ethylbenzene
48-hr LC50 = 20 mmol/m^3 for *Daphnia magna*[73]
Ethyl methanesulphonate
Induced nuclear anomolies in *Umbra pygmaea* erythrocytes[343]
Ethyl propionate
Susceptibilities of 22 species from bacteria through amphibians = 14–1 220 mg/L[5]
48-hr LC50s for macroinvertebrates = 20–1 000 mg/L[7]
Etomidate
A useful anesthetic for three fishes[224,344]
Falpet
Acute toxicity to *Oryzias latipes*[8]
Fenapanil (RH-2161)
Hematological effects on *Trichogaster fasciatus*[345]
Fenitrothion (Sumithion)
Toxicity to two algae and *Daphnia magna*[47]
Adaptation by carp[200]
Acute toxicity to five species[212]
24-hr LC50 for common carp = 1.5 mg/L[234]
Factors affecting bioavailability to plants and animals[283]
BCF = 26 with *Lemna minor*[298]
Various effects on *Oziotelphusa senex*[346–351]
Induced invertebrate drift in a stream[352]
Effects of co-solvents on uptake by two algae[353]
96-hr LC50 for *Mystus cavasius* and *Labeo rohita* = 2.8–4.6 mg/L[354]
Fennosan
Acute toxicity to brown and rainbow trout[4]
Fensulfothion (Dasanit)
Effects on bluegill ATPases[33]

Pollutant Type of Information
Fenthion (Baytex)
EC50 = 3 330 µg/L for *Chlamydomonas reinhardii*[16]
Chronic effects on *Lymnaea stagnalis*[205]
Biochemical effects on *Heteropneustes fossilis*[355]
Fenvalerate (Pydrin) (see also pyrethroids)
Toxicity to fathead minnow reduced by bentonite[82]
Effected nerve impulses in *Xenopus laevis*[120]
96-hr LC50s for fathead minnow and rainbow trout = 5.4 and 2.1 µg/L[331]
MATC = 0.33–0.43 µg/L and BCF = 3 200 for fathead minnow[356]
Toxicity to and uptake by *Procambarus clarki* and channel catfish[357]
28-day lethality and bioconcentration tests with various invertebrates[358]
Ferrocyanide
Increased oxygen consumption of *Corbicula regularis*[69]
Fluchloralin (Basalin)
Biochemical effects on *Nemachelius denisonii*[359]
Fluoranthene
Affected growth of *Anabaena flos-aquae*[2]
Fluorene
Affected growth of *Anaebena flos-aquae*[2]
2-Fluorenylacetamide
150 mg/kg in feed damaged liver of *Oryzias latipes*[15]
2-Fluorenylamine
300 mg/kg in feed damaged liver of *Oryzias latipes*[15]
Fluoride
Toxicity to *Elodes densa*[65]
Physiological effects on *Channa punctatus*[360]
96-hr LC50 = 1.6–11.8 mg/L for three fishes; teratogenicity[361]
Fluridone
Factors affecting bioavailability to plants and animals[283]
BCF = 6 with *Lemna minor*[298]
Fly ash
Effects on lake zooplankton[362]
Fonofos
96-hr LC50 = 1 090 µg/L and MATC = 16–33 µg/L for fathead minnow[20]
Formalin
Toxicity to *Rana berlandieri* and largemouth bass (*Micropterus salmoides*)[363]
Formothion
96-hr LC50 = 8.56 mg/L for *Lymnaea acuminata*; effects of synergists[201]
Fosamine ammonium (Krenite)
BCF = 4 with *Lemna minor*[298]
Furan
96-hr LC50 for fathead minnow = 61 mg/L[10,11]
Guaiacol (2-Methoxyphenol)
Toxicity to two plants[216]
Heparin
Distribution in three species[364]

(Table 1 Continued)

Table 1—(Continued)

Pollutant
Type of Information

Heptachlor and Heptachlor epoxide
- LC50s for *Aplexa hypnorum* and *Tanytarsus dissimilis* = 1.45 and >2.5 μg/L[3]
- Concentrations in various fishes[22,25,29,34]
- BCF = 2 330–10 630 with *Corbicula manilensis*[30]
- Effects on bluegill ATPases[33]
- 4-hr EC50 = 10 mg/L for *Nitrobacter* and >100 mg/L for *Nitrosomonas*[187]

Heptanol
- Susceptibilities of 22 species from bacteria through amphibians = 4–160 mg/L[5]
- 48-hr LC50s for 15 macroinvertebrates = 26–200 mg/L[7]
- Acute toxicity to six species[8]

Hexachlorobenzene
- 96-hr LC50 for fathead minnow was above saturation[10,11]
- Concentrations in various fishes[22,29,285]
- Acute toxicity to five species[212]
- Concentrations in biota in treated ponds[233]
- Toxicity to various species[310]
- Related to flavor impairment[365]

Hexachlorocyclohexane (see also lindane)
- Concentrations in various fishes[22,25,29,31,288]
- BCF = 2 240 with *Corbicula manilensis*[30]
- 48-hr LC50 for Mozambique tilapia = 3.199 mg/L[203]
- Concentrations in 18 Chinese species[299]
- Biochemical changes in *Oziotelphusa senex*[366]
- Histopathological changes in *Trichogaster fasciatus*[367]
- Biochemical effects on a freshwater crab[368]

Hexachlorocyclopentadiene
- 130 μg/L increased oxygen consumption by rainbow trout[369]
- Uptake by rainbow trout[370]

Hexachloroethane
- 96-hr LC50 = 1.5 mg/L for fathead minnow[10,11]

Hexane
- 48-hr LC50 = 45 mmol/m^3 for *Daphnia magna*[73]
- Toxicity thresholds = 105 mmol/m^3 for two protozoa[112]

Hexanol
- 96-hr LC50 = 97 mg/L for fathead minnow[10,11]

Hydrazines
- EC50 = 14.6–145 mg/L for four bacteria[371]
- Effects on embryos and larvae of rainbow trout[372]

IBP (Kitazin)
- 24-hr LC50 for common carp = 3.7 mg/L[234]
- 96-hr LC50 = 14–16 mg/L for two fishes[373]

Igran Special
- 48-hr LC50 = 4.3–20.1 mg/L for three fishes[14]

Industrial effluents
- Retarded ovarian maturation of *Channa punctatus*[374]
- Biochemical effects on rice seedlings[375]

Iron
- Concentrations in various fishes[29,144]
- Concentrations in six Canadian species[44]
- Relationship of feeding habits to concentrations in insects[79]
- Relationship of size to concentrations in insects[80]

Iron (Continued)
- Concentrations in European mosses[106,147]
- Concentrations in *Rhynchostegium riparioides* in England[107]
- Concentrations in European *Fontinalis antipyretica*[141]
- Concentrations in Canadian *Sphagnum magellanicum*[143]
- Uptake by two fishes in a lake[221]
- Toxicity to river algal communities[256]
- 5.7 mg/L delayed embryogenesis in rainbow trout[376]

Iron (II)
- Toxicity to *Elodes densa*[65]
- Toxicity of a mixture to four algae[95]
- Impaired hatch of common carp[178]

Iron (III)
- Toxicity to *Daphnia middendorffiana*[38]
- Reduced toxicity of cadmium to a diatom[151]
- Affected stream community structure and metabolism[377]

Isophorone
- 96-hr LC50 = 145–255 mg/L and NOEC = 14 mg/L for fathead minnow[1]

Isoprothiolane
- EC50 = 3 400 μg/L for *Chlamydomonas reinhardii*[16]
- Acute toxicity to two amphibians[36]

Jet fuels (JP–4 and JP–8)
- 2.3 mg/L increased pectoral fanning by bluegills[379]
- Morphological effects on mosquitofish[380]
- Effects on histopathology of fathead minnows[381]
- Toxicity to three fishes[382]

Kelthane
- 96-hr LC50 for fathead minnow and rainbow trout = 510 and 210 μg/L[331]
- MATC = 19–39 μg/L for fathead minnow and amphipod; BCF = 3 700–10 000[356]
- BCF with fathead minnow = 9 500–18 900; BCF was decreased by clay[383]

Kepone (Chlordecone)
- Uptake from wastewater by two fishes[32]
- Effects on bluegill ATPases[33]
- 48-hr EC50 = 120–670 μg/L for *Daphnia magna*[323]
- No significant inhibition of general microbial activity[384]

LAS (see also detergents)
- 48-hr LC50 for *Daphnia magna* = 4.8 mg/L[19]
- 48-hr EC50 = 2.2–10.1 mg/L for *Daphnia magna*[323]

Leachates
- Affected growth of *Anabaena flos-aquae*[118]
- Impacts on a stream community[385]
- Review of effects on aquatic biota[386]
- Acute toxicity to three species[387]

Lead
- Concentrations in various fishes[29,133,150,153,395]
- Uptake from wastewater by two fishes[32]
- Concentrations in six Canadian species[44]
- Toxicity to *Elodes densa*[65]
- Concentrations in *Pacifastacus trowbridgi*[87]
- Concentrations in Great Lakes biota[88]
- Uptake by 20 algae[92]

Table 1—(Continued)

Pollutant Type of Information
Lead (Continued)
1500 µmol/L killed *Poteriochromonas malhamensis*[94]
Toxicity of a mixture to four algae[95]
Concentrations in European mosses[106,147]
Concentrations in *Rhynchostergium riparioides*[107]
Relatively non-toxic to *Ankistrodesmus* sp. at pH 5 and 7[122]
Toxicity to and uptake by two algae[132]
Toxicity to 87 species of Chlorophyta[139]
Concentrations in European *Fontainalis antipyretica*[141]
Concentrations in English invertebrates[142]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Effects on three aquatic angiosperms[158]
96-hr EC50 = 11 mg/L for diatom *Navicula incerta*[163]
4-hr EC50 = 10 mg/L for *Nitrobacter* and 100 mg/L for *Nitrosomonas*[167]
Concentrations in river otters[168]
96-hr EC50 for *Chlorella saccharophila* = 63.8 mg/L[175]
Impaired hatch of common carp[178]
Uptake by liverwort[191]
96-hr LC50 = 26 mg/L for *Channa punctatus*[194]
Toxicity to river algal communities[256]
10 µg/L caused cytological changes in algae[260]
Concentrations in macrophytes[261]
Concentrations in Irish *Sphagnum*[263]
Caused black tails and spinal curvature in rainbow trout[388]
Effects of geochemical factors on concentrations of aufwuchs[390]
Sublethal effects on bluegill[391]
Eliminated by *Physa integra* much faster than by *Compeloma decisum*[392]
Physiological effects on rainbow trout[393]
Effect on ALAD activity in lake trout (*Salvelinus namaycush*)[394]
Review of effects on aquatic life[396]
Lead, organo
50 µmol/L killed *Peteriochromonas malhamensis*[94]
Lindane (see also hexachlorocyclohexane)
BCF with *Corbicula manilensis* = 2 610[30]
Effects on bluegill ATPases[33]
Concentrations in various fishes[34,285]
Chronic effects on *Lymnaea stagnalis*[205]
96-hr LC50 for *Gammarus pulex* = 5.9–13.6 µg/L; delayed mortality[270]
Physiological effects on brown trout[397]
Accumulation in *Channa punctatus*[398]
Biochemical effects on *Anabas testudineus*[399]
BCF = 420 for bluegill[400]
96-hr LC50 = 75 µg/L for *Gobio gobio;* concentrations in tissues[401]
MCPA
Review of effects on aquatic life[402]
MIPC
Acute toxicity to two amphibians[36]
MS-222 (Tricaine methanesulfonate)
Physiological effects on striped bass[224]
Magnesium
Concentrations in six Canadian species[44]
Concentrations in *Rhynchoestegium riparioides* in England[107]
Physiological effects on *Rana catesberana* and *R. nigromaculata*[199]
Acute and chronic toxicity to *Daphnia magna*[403]
Malachite Green
48-hr LC50 for *Oryzias latipes* = 0.3 mg/L[12]
Malathion
Effects on bluegill ATPases[33]
Concentrations in Texas fish[34]
48-hr LC50 for Mozambique tilapia = 0.367 mg/L[203]
Biochemical effects on *Sarotheradon mossambicus*[293]
Photodegradation increased toxicity to fish[307]
Accumulation in *Channa punctatus*[398]
Caused initial population shift followed by recovery[404]
Biochemical effects on *Clarias batrachus*[405]
48-hr LC50 = 1.63 mg/L for *Macrobrachium lamerri*[406]
96-hr LC50 = 8.50 mg/L for *Heteropneustes fossilis;* biochemical effects[407]
Acute effects on *Clarias batrachus*[408]
Manganese
Concentrations in Mississippi fishes[29]
Concentrations in six Canadian species[44]
Toxicity to *Elodes densa*[65]
Relationship of size to concentrations in insects[80]
Concentrations in European mosses[106,147]
Concentrations in *Rhynchostegium riparioides* in England[107]
Concentrations in European *Fontinalis antipyretica*[141]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Concentrations in Indian fish[144]
Mepronil
Toxicity to 14 species[110]
Mercury
Concentrations in various fishes[29,133,150,294,409,414,416,418,419]
Uptake from wastewater by two fishes[32]
Concentrations in six Canadian species[44]
Concentrations in Great Lakes biota[86]
Concentrations in snapping turtles[129]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Food chain dynamics in Finnish lakes[213]
Uptake by two fishes in a lake[221]
Concentrations in 18 Chinese species[299]
Concentrations in 11 species of fish, a crayfish, and California seagull[410]
Reduction of concentration in eels[411]
Effect of pH on uptake by fish[412]
Caused deformities in *Pornatothrix hammoniensis*[413]
Concentrations in various Spanish species[415]
Concentrations in sediment and *Gammarus pulex*[417]
Reduced oxygen consumption of young pink salmon (*Oncorhynchus gorbuscha*)[420]
Mercury (II)
96-hr LC50 for bluegill and *Aplexa hypnorum* = 160 and 360 µg/L[3]
Susceptibilities of 22 species from bacteria through amphibians = 0.0013–5.6 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 0.01–10 mg/L[7]
Acute toxicity to six species[8]
Avoidance tests with three carps[55]
Toxicity to *Elodes densa*[65]
Reduced oxygen consumption of *Corbicula regularis*[69]
Uptake by *Chlorella kessleri*[90]
Uptake by 20 algae[92]
25 µmol/L killed *Poteriochromonas malhamensis*[94]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Mercury (Continued)
Toxicity of a mixture to four algae[95]
More toxic to *Ankistrodesmus* sp. at pH 5 than 7[122]
24-hr LC50 for *Danio malabaricus* = 2 mg/L and for *Puntius ticto* = 0.38 mg/L[134]
Effects on three aquatic angiosperms[158]
Affected sensitivity of white sucker to cadmium[173]
96-hr LC50 for *Lymnaea acuminata* = 0.023 mg/L[177]
Toxicity to *Oryzias latipes* reduced by selenium (IV)[189]
96-hr LC50 = 0.9 mg/L for *Channa punctatus*[194]
Various effects on *Sarotherodon mossambicus*[293,423]
48-hr EC50 = 6–20 µg/L for *Daphnia magna*[323]
Sublethal effects on *Channa punctatus*[421,428,430,434,435]
Toxicity to *Ankistrodesmus braunii*[422]
Groups of goldfish survived longer than individual fish[424]
Physiological effects on *Notopterus notopterus*[425]
Effect on respiration of three algae[426]
Biochemical changes in *Notopterus notopterus*[427]
Toxicity to lake trout embryos was decreased by selenium (IV)[429]
Inhibited growth of *Poteriochromonas malhamensis*[431]
Acute toxicity to rainbow trout and *Zebra danio*[432]
BCF = 40 000 for *Chlorella vulgaris*[433]
Physiological effects on toadfish[436]
Effects of low pH, selenium, and calcium on uptake by crayfish[437]
Uptake by biota in a stream[438]
Mercury, organo
0.2 µmol/L killed *Poterioochromonas malhamensis*[94]
Food chain dynamics in Finnish lakes[213]
Inhibited growth of *Poteriochromonas malhamensis*[431]
BCF = 40 000 for *Chlorella vulgaris*[433]
Uptake by biota in a stream[438]
96-hr LC50 = 205–445 µg/L for common carp[439]
Decreased visual sensitivity of rainbow trout[441]
Uptake by northern pike (*Esox lucius*) decreased by selenium (IV)[442]
Uptake by *Chlorella kessleri*[443]
Water quality modified uptake by rainbow trout[444]
Uptake by four species in a microcosm[445]
Hematological effects on bluegill[446]
Mesulfenfos
Toxicity to 14 species[110]
Metasystox (Methyl demeton)
Toxicity to *Elodes densa*[65]
Metflurazon
Metabolic effects on *Chlorella fusca*[447]
Methabenzthiazuron (Tribunil)
48-hr LC50 = 24.4–71.8 mg/L for three fishes[14]
Methanol
96-hr LC50 = 28 000 mg/L for fathead minnow[10,11]
Methoprene (Altosid)
Chronic toxicity to *Daphnia magna*[318]
Methoxychlor
Concentrations in various fishes[29,34]
Effects on bluegill ATPases[33]
Neurophysiological effects on *Procambarus clarki*[35]
Factors affecting bioavailability to plants and animals[283]
BCF = 242 with *Lemna minor*[298]

Pollutant Type of Information
Methoxyphenone
Review of effects on aquatic life[402]
Methylamine
48-hr LC50 for *Oryzias latipes* = >1 000 mg/L[12]
9-Methylanthracene
48-hr LC50 = 2.3 mmol/m^3 for *Daphnia magna*[73]
3-Methylcholanthrene
Biochemical effects on blue tilapia (*Tilapia aurea*)[449]
Methylcyclohexane
48-hr LC50 = 15 mmol/m^3 for *Daphnia magna*[73]
Methylene Blue
48-hr LC50 for *Oryzias latipes* = 13 mg/L[12]
Methylene chloride
96-hr LC50 = 13–34 mg/L for two fishes[114]
1-Methylnaphthalene
48-hr LC50 = 13 mmol/m^3 for *Daphnia magna*[73]
1-Methyl-3-nitro-1-nitroguanidine
Mutagenic effects on goldfish cells[197]
Methylnitrophenols
Acute toxicity = 19–47 mg/L for *Daphnia magna* and fathead minnow[49]
Methyl parathion
Concentrations in Texas fish[34]
Toxicity to *Elodes densa*[65]
Biochemical effects on Mozambique tilapia[450]
96-hr LC50 for rainbow trout = 2.8 mg/L; delayed mortality[451]
48-hr LC50 = 0.26 mg/L for Mozambique tilapia[452]
4-Methyl-2-pentanone
96-hr LC50 for fathead minnow = 505 mg/L[10,11]
3-Methylphenol
96-hr LC50 for guppy[126]
N-(1-Methyl-1-phenylethyl)acylamide
Structure-activity relationship for inhibition of growth of *Scirpus juncoides*[448]
Mexacarbate (Zectran)
96-hr LC50 = 1.7 mg/L for *Lymnaea acuminata*; effects of synergists[201]
Biochemical effects on *Lymnaea acuminata*[453]
Mine drainage
Reduced tolerance levels of *Desmognathus fuscus*[454]
Effects on algal community[455]
Field effects on periphyton, benthic invertebrates, and fishes[456]
Mirex
Concentrations in various[22,29,457]
Uptake from wastewater by two fishes[32]
Concentrations in Great Lakes biota[86]
Acute toxicity to and uptake by *Hyalella azteca* and *Crangonyx pseudogracilis*[458]
Concentrations in Canadian eels[459]

Table 1—(Continued)

Pollutant Type of information
Molinate (Ordram)
Review of effects on aquatic life[402]
Acute effects on young Russian sturgeon[460]
Concentrations in Japanese fishes[607]
Molybdenum
Toxicity to 32 bacteria and *Daphnia magna*[43]
Concentrations in six Canadian species[44]
Affected growth of *Anabaena flos-aquae*[118]
Uptake by stream insects in field study[162]
Concentrations in six species of aquatic insects[461]
2-Monochlorobiphenyl
Acute toxicity = 0.42–4.0 mg/L for four species[121]
Monocrotophos
LC50 = 1287.5–1562.5 mg/kg for Mozambique tilapia[214]
96-hr LC100 for Mozambique tilapia = 18.62 mg/L[215]
48-hr LC50 = 4.46 mg/L for *Macrobrachium lamerrii*[406]
Morpholine
96-hr tests on alga, *Daphnia magna*, and rainbow trout[70]
Mosquito control oils
Field trials for safety and efficacy[462]
Musk, synthetic
Bioaccumulation by three fishes[463]
Naphthalene
Affected growth of *Anabaena flos-aquae*[2]
48-hr LC50 = 130 mmol/m^3 for *Daphnia magna*[73]
96-hr LC50 for *Daphnia pulex* = 1 000 µg/L; uptake and depuration[111]
Toxicity thresholds for two protozoa were above solubility[112]
96-hr LC50 = 1.6 mg/L for rainbow trout and 7.9 mg/L for fathead minnow; MATC for fathead minnow = 0.45–0.85 mg/L[113]
Effects on neurotransmitters and osmoregulation in channel catfish[116,167]
Acute and chronic toxicity to *Daphnia pulex*[272]
BCF = 98 for bluegill[400]
Uptake by *Daphnia pulex*[464]
Effects on growth of pink salmon[465]
Biochemical effects on *Sarotherodon mossambicus*[466]
96-hr LC50 for *Somatochlora cingulata* = 1–2.5 mg/L; 0.1 mg/L increased oxygen consumption[467]
96-hr LC50 for *Xenopus laevis* larvae = 2.1 mg/L[468]
Uptake by fathead minnows exposed to refined oil[469]
Naphthoic acids
28 µg/L did not affect growth of *Anabaena flos-aquae*[118]
Naphthols
Uptake and metabolism by 12 fishes[235]
Physiological effects on rainbow trout[470]
Nickel
Concentrations in various fishes[29,133,144,153]
Toxicity to *Daphnia middendorffiana*[36]
Concentrations in six Canadian species[44]
Uptake by 20 algae[92]
Toxicity of a mixture to four algae[95]
Concentrations in *Rhynchostegium riparioides* in England[107]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Uptake and effect on growth of *Hydro littoralis*[146]

Pollutant Type of information
Nickel (Continued)
Concentrations in European mosses[147]
96-hr LC50 for *Lymnaea acuminata* = 2.78 mg/L[177]
Impaired hatch of common carp[178]
96-hr LC50 = 307 mg/L for *Channa punctatus*[194]
Acute toxicity and bioconcentration by rainbow trout in presence of chlorine[227]
Acute and chronic toxicity to three microbes[471]
Inhibited growth of *Scenedesmus quadricauda* and *Ankistrodesmus falcatus*[472]
Niclosamide (Bayluscide)
Factors affecting bioavailability to plants and animals[283]
Nitrite
Influenced motility behavior of rainbow trout[59]
Effect with and without chloride on methemoglobin in channel catfish[225,476]
96-hr LC50 = 13.7 mg/L for channel catfish; chronic effects[473]
Acclimation by channel catfish[474]
Uptake and loss in two salmonids[475]
Toxicity to several species[478]
Physiological effects on rainbow trout[479]
96-hr LC50 = 13.7 mg/L for channel catfish; hematological and histological effects[480]
BCF with rainbow trout = 60; physiological effects[481]
Nitrobenzenes
48-hr LC50 for *Oryzias latipes* = 20 mg/L[12]
96-hr LC50 = 0.6–7.0 mg/L for fathead minnow[50]
96-hr LC50 = 0.002 mg/L for rainbow trout[114]
Physiological effects on rainbow trout[470]
Nitrophenols
96-hr LC50 for guppy[126]
4-Nitroquinoline-1-oxide
Mutagenic effects on goldfish cells[197]
N-Nitrosodiethylamine
100 mg/kg in water damaged liver of *Oryzias latipes*[15]
Nitrotoluenes
Acute toxicity = 12–>77 mg/L for *Daphnia magna* and fathead minnow[49]
96-hr LC50 = 0.1–49.7 mg/L for fathead minnow[50]
1-Nonanol
96-hr LC50 = 5.7 mg/L for fathead minnow[10,11]
Octachlorostyrene
Concentrations in spottail shiner (*Notropis hudsonius*) from Niagara River[22]
Octane
48-hr LC50 = 3.3 mmol/m^3 for *Daphnia magna*[73]
Oils
Acute and chronic toxicity to *Daphnia pulex*[272,464,483]
Effects on growth of pink salmon[465]
Predicted MATC for cutthroat trout (*Salmo clarki*) = 24–39 µg/L[469]
Impaired ability of coho salmon to capture prey[482]
Acute and chronic toxicity to *Daphnia magna*[484,486]
Toxicity to four species[485]
Temporarily affected pond microcosms[487]
Affected nutrient exchange in microcosms[488]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Oryzalin
Acute toxicity to fish and crayfish[489]
Oxadiazon
Acute toxicity to two amphibians[36]
Oxalate
Reduced oxygen consumption of *Corbicula regularis*[89]
Oxamyl
Acute toxicity to two amphibians[36]
Toxicity to 14 species[110]
PAHs (Polycyclic aromatic hydrocarbons)
Affected growth of *Anabaena flos-aquae*[2]
Caused neoplasms in Niagara River fish[490]
PCBs
100 mg/kg in feed damaged liver of *Oryzias latipes*[15]
Concentrations in various fishes[22,23,25,29,34,150,223,285,294,309,495,499,501]
Uptake from wastewater by two fishes[32]
48-hr LC50 = 2 mmol/m^3 for *Daphnia magna*[73]
Concentrations in Great Lakes biota[88]
Effects on neurotransmitters in channel catfish[116]
Acute toxicity = 0.03–0.12 mg/L for three species[121]
Concentrations in snapping turtles[129]
Food chain dynamics in Finnish lakes[213]
Factors affecting bioavailability to plants and animals[283]
Concentrations in Israeli aquatic life[289]
BCF = 2 200 with *Lemna minor*[298]
Impaired ability of coho salmon to capture prey[482]
BCF = 4.9–37 for three algae[491]
Effects on phytoplankton[492]
Model of uptake by five species[493]
Concentrations in biota from Lake Huron[494]
10 μg/L inhibited nitrification[496]
Concentrations in Lake Geneva biota[497]
No effects on larval striped bass[498]
Concentrations in Hudson River fish decreased from 1977 to 1981[500]
Toxicity to *Klebsiella pneumoniae*[502]
3- to 4-day BCFs = 30–200 with three species[503]
Physiological effects on rainbow trout[504]
Decreased aflatoxin-initiated carcinogenesis and mutagenesis in rainbow trout[505]
Effect on phytoplankton uptake of C-14[506]
Study of uptake by plankton in microcosms[507]
Uptake by *Chlorella fusca*[508]
Accumulation by *Chironomus plumosus* and *Tubifex tubifex* in microcosm[509]
Effects on various algae[510,511]
Mass balance in brook and rainbow trout[512]
pH, low
Toxicity to various invertebrates[36]
Influenced motility behavior of rainbow trout[59]
Reduced growth of *Ankistrodesmus* sp.[122]
Effect of pH = 4.5 on Atlantic salmon eggs[513]
Effects on acidified lakes[514]
Effects on daphnia respiration[515]
Biochemical effects on *Clarias mossambicus*[516]
Field effects on fathead minnow and macroinvertebrates[517]
Gulf killifish (*Fundulus grandis*) became hyperactive at pH = 5[518]

Pollutant Type of Information
pH, low (Continued)
Yellow perch from acidic lakes developed tolerance to low, but not high, pH[519]
Review of effects on fish gills[520]
Effects on seven invertebrate species[521]
Effects on exercised rainbow trout[522]
Effects on aquatic ecosystems[523]
Impact on fisheries[524]
Caused loss of calcium from gills of brown trout[525]
Increased drift of macroinvertebrates[526]
Review of effects[527]
Review of effects on fishes[528]
Physiological effects on brown trout[529,530]
Acute toxicity to salamanders[531]
Reduced numbers of phytoplankton species[532]
Paraquat
Review of effects on aquatic life[402]
Parathion
Effects on bluegill ATPases[33]
Concentrations in Texas fish[34]
4-hr EC50 = 500 mg/L for *Nitrobacter* and >100 mg/L for *Nitrosomonas*[167]
Dynamics in aquatic ecosystem[289]
Effect on learning and retention by goldfish[533]
Uptake by cricket frog[534]
Particulate matter
Coho salmon avoided high levels[535]
Pendimethalin
Toxicity to 14 species[110]
Pentachlorobenzene
96-hr LC50 for fathead minnow was above saturation[10,11]
Concentrations in spottail shiner from Niagara River[22]
48-hr LC50 = 5 mmol/m^3 for *Daphnia magna*[73]
Pentachloroethane
96-hr LC50 for fathead minnow = 7.3 mg/L[10,11]
Pentachloronitrobenzene
Concentrations in biota in treated ponds[233]
Pentachlorophenol
Susceptibilities of 22 species from bacteria through amphibians = 0.16–34 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 0.11–42 mg/L[7]
Acute toxicity to six species[8]
Avoidance tests with three carps[55]
Review of effects on fishes[72]
Effect of pH on acute toxicity and bioconcentration with guppy[126]
Food chain dynamics in Finnish lakes[213]
24-hr LC50 for common carp = 0.10 mg/L[234]
96-hr LC50 for *Notopterus notopterus* = 0.032–0.13 mg/L; effect of size, other phenols, and temperature[312,328]
Biochemical effects on *Notopterus notopterus;* mixtures with other phenols[324–326]
Not related to flavor impairment[365]
Review of effects on aquatic life[402]
Acute and chronic toxicity to *daphnia magna*[403]
Effect on photosynthesis and growth of three algae[511]
96-hr LC50 = 0.16–0.19 mg/L for *Lymnaea acuminata*[536]

Table 1—(Continued)

Pollutant Type of Information
Pentachlorophenol (Continued)
Uptake from food by rainbow trout; concentrations in six Canadian fishes[537]
Sublethal effects on three fishes[538]
96-hr LC50 = 148 μg/L for *Rasbora daniconius*[539]
Metabolic effects on *Lemna minor*[540]
Effect on primary production in experiment ponds[541]
96-hr LC50 = 470 μg/L for fathead minnow; results of 90-day tests were affected by impurities[542]
Pentane
48-hr LC50 = 135 mmol/m^3 for *Daphnia magna*[73]
Permethrin (Ambush) (see also pyrethroids)
Neurophysiological effects on *Procambarus clarki*[35]
Toxicity to fathead minnow reduced by bentonite[82]
Effected nerve impulses in *Xenopus laevis*[120]
Factors affecting bioavailability to plants and animals[283]
BCF = 260 with *Lemna minor*[298]
Forest spraying altered species diversity[300]
96-hr LC50s for fathead minnow and rainbow trout = 16 and 7 μg/L[331]
Toxicity to and uptake by *Procambarus clarki* and channel catfish[357]
28-day lethality and bioconcentration tests with several invertebrates[358]
Predicted MATC and BCF for fathead minnow = 0.66–1.4 μg/L and 2 800 respectively; *Heliosoma trivolvis* was slightly affected at 0.33 μg/L; BCF = 800[543]
More toxic to rainbow trout than to mice[544,546]
6-hr LC50 = 0.58–2.06 μg/L for *Hexagenia rigida;* delayed mortality[545]
Pesticides
Acute toxicities to various species[547–551]
Petroleum wastewater
MATC for flagfish (*Jordanella floridae*) = 1–28%[552]
10% reduced 44-day growth of rainbow trout[553]
Decreased Shannon-Weaver diversity index of macrobenthos[554]
Chronic effects on rainbow trout and fathead minnow[555]
48-hr EC50 = 3.6–98% for *Daphnia magna*[556]
Phenanthrene
Affected growth of *Anabaena flos-aquae*[2]
48-hr LC50 = 6.5 mmol/m^3 for *Daphnia magna*[73]
96-hr LC50 for *Daphnia pulex* = 100 μg/L; uptake and depuration[111]
Acute and chronic toxicity to *Daphnia pulex*[272]
Phenazine-5-oxide
EC50 = 900 μg/L for *Chlamydomonas reinhardii*[16]
Phenobarbital
100 mg/kg in feed damaged liver of *Oryzias latipes*[15]
Phenol
48-hr LC50 with *Daphnia magna* = 7.7 mg/L[19]
Concentrations in Mississippi fishes[29]
Avoidance tests with three carps[55]
Influenced motility behavior of rainbow trout[59]
Toxicity to *Elodes densa*[65]
48-hr LC50 = 319 mmol/m^3 for *Daphnia magna*[73]
96-hr LC50 = 0.15 mg/L for rainbow trout and 32 mg/L for fathead minnow[114]

Pollutant Type of Information
Phenol (Continued)
Effect of pH on acute toxicity to guppy[126]
Toxicity to two plants[218]
96-hr LC50 for *Gammarus pulex* = 40–51 mg/L; delayed mortality[270]
96-hr LC50 for *Notopterus notopterus* = 8.1–14 mg/L; effect of size, other phenols, and temperature[312,326]
Biochemical effects on *Notopterus notopterus;* mixtures with other phenols[324–326,559]
96-hr LC50 = 128.75 mg/L for *Lymnaea acuminata*[536]
Toxicity to three snails[557]
Physiological effects on common carp[558]
Toxicity to and uptake by two snails[560]
Uptake and depuration by three fishes[561]
2-Phenoxyethanol
96-hr LC50 = 345 mg/L for fathead minnow[10,11]
Phenthoate
24-hr LC50 for common carp = 0.84 mg/L[234]
Phenylhydrazine
48-hr LC50 for *Oryzias latipes* = 15.7 mg/L[12]
Phorate (Thimet)
Effects on bluegill ATPases[33]
96-hr LC50 = 15 mg/L for *Lymnaea acuminata;* effect of synergists[201]
Biochemical effects on *Lymnaea acuminata*[453]
Phosphamidon (Dimecron)
96-hr LC50 = 12.45 mg/L for *Ranatra elongata*[28]
Biochemical effects on *Clarias batrachus*[405]
48-hr LC50 = 1.63 mg/L for *Macrobrachium lamerrii*[406]
LC50 for *Lamellidens marginalis* = 20 mg/L; 8 mg/L affected metabolism[562]
Phosphates, alkyl and aryl
Comparison of results of laboratory and field exposures of *Daphnia magna* and fathead minnow[127]
Factors affecting bioavailability to plants and animals[283]
BCF = 283 with *Lemna minor*[298]
Metabolism by fathead minnow[615]
96-hr LC50 for rainbow trout = 0.36 mg/L; no delayed mortality[617]
Phosphorus
Concentrations in six Canadian species[44]
Phthalates
96-hr LC50 for *Gammarus pulex* >0.4 mg/L[270]
Effect of solvents and food on acute toxicity to *Daphnia magna*[323]
Not bioaccumulated by *Corbicula*[563]
Picramic acid (2-Amino-4,6-dinitrophenol)
Cause petechial hemorrhages in rainbow trout[564]
Picric acid (2,4,6-Trinitrophenol)
48-hr LC50 for *Oryzias latipes* = 117 mg/L[12]
Caused petechial hemorrhages in rainbow trout[564]
Piperonyl butoxide
Effects on toxicity of four pesticides to a snail[201]
Piperophos
Review of effects on aquatic life[402]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Potassium
Relationship of feeding habits to concentrations in insects[79]
Relationship of size to concentrations in insects[80]
Acute and chronic toxicity to *Daphnia magna*[403]
Pristane
Effects on rainbow trout lipids[333]
Procymidone
Acute toxicity to two amphibians[36]
Toxicity to 14 species[110]
Prometryn
Toxicity to common carp[103]
Propanil
96-hr LC50 for fathead minnow = 8.6 mg/L; MATC = 0.4–0.6 μg/L; BCF = 1.6[565]
Propanol
Susceptibilities of 22 species from bacteria through amphibians = 91–6 800 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 1 000–9 200 mg/L[7]
Acute toxicity to six species[8]
96-hr LC50 for fathead minnow = 10 400–9 640 mg/L[10,11]
Propazine
Toxicity to common carp[103]
Pulp mill effluent
Study of components causing flavor impairment[365]
Acute and chronic effects on zebrafish (*Brachydanio rerio*)[566]
Biochemical effects on rainbow trout[567]
Toxicity reduced by treatment[568]
Analysis of components causing flavor impairment of fish[569]
Toxicity to *Selenastrum capricornutum*[570]
Increased fecal coliform (*Klebsiella pneumoniae*) in Canadian river[571]
Pyrene
Did not affect growth of *Anabaena flos-aquae*[2]
48-hr LC50 = 9 mmol/m^3 for *Daphnia magna*[73]
Pyrethroids (see also fenvalerate and permethrin)
Neurophysiological effects on *Procambarus clarki*[35]
Acute toxicity to two amphibians[36]
Effected nerve impulses in *Xenopus laevis*[120]
Forest spraying altered species diversity[303]
96-hr LC50, predicted MATC, and BCF for fathead minnow = 0.22 μg/L, 0.03–0.07 μg/L, and 400, respectively[543]
Pyridine
Susceptibilities of 22 species from bacteria through amphibians = 3.9–2 470 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 30–2 400 mg/L[7]
Acute toxicity to six species[8]
48-hr LC50 for *Oryzias latipes* = 330 mg/L[12]
Quinaldine
Physiological effects on striped bass[224]
Quinalphos
LC50 = 312.5 mg/kg for Mozambique tilapia[214]
96-hr LC100 for Mozambique tilapia = 6.91 mg/L[215]
Radiation
Mutagenic effects on goldfish cells[197]

Pollutant Type of Information
Radiation (Continued)
Review of effects on aquatic organisms[572]
Decreased fertility and hatchability of *Oryzias latipes*[573]
Radionuclides
Concentrations in two Russian fishes[574]
Resin acids
Physiological effects on rainbow trout[575]
Rhodamine B
48-hr LC50 for *Oryzias latipes* = 12 mg/L[12]
Rose Bengal
48-hr LC50 for *Oryzias latipes* = 100 mg/L[12]
Rotenone
Acute toxicity to two amphibians[36]
With antimycin A, impacted lake zooplankton[81]
Toxicity to fathead minnow reduced by bentonite[82]
96-hr LC50 = 0.34–7.95 mg/L for 15 species[576]
Field study of effects on pond invertebrates[577]
Runoff
Toxic to *Selenastrum capricornutum*[578]
Caused fish kills[579]
Acute toxicity to benthic macroinvertebrates[580]
MATC = 28% for fathead minnow; field effects[581]
Salicylaldehyde
Susceptibilities of 22 species from bacteria through amphibians = 1.15–54 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 1.3–13 mg/L[7]
Acute toxicity to six species[8]
Toxicity to fathead minnow reduced by bentonite[82]
Salinity
Mosquitofish tolerate 39–58.8 g/kg[582]
Scandium
Relationship of feeding habits to concentrations in insects[79]
Relationship of size to concentrations in insects[80]
Selenium
Concentrations in Mississippi fishes[29]
Concentrations in Great Lakes biota[88]
Effect on toxicity of cadmium to a snail and an alga[156]
Affected sensitivity of white sucker to cadmium[173]
Uptake by two fishes in a lake[221]
Caused hematological changes in redear sunfish (*Lepomis microlophus*)[583]
Review of effects on fish[584]
Selenium (IV)
Toxicity of a mixture to four algae[95]
Reduced sensitivity of *Oryzias latipes* to mercury (II) and cadmium[189]
100 mg/L decreased toxicity of mercury (II) to lake trout embryos[429]
Decreased uptake of mercury by northern pike[442]
5 μg/L affected activity of bluegills and largemouth bass[585]
48-hr LC50 for *Daphnia magna* = 3.87 mg/L; MATC = 0.2–0.4 mg/L[586]
0.1 mg/L reduced lake zooplankton[587]
Silver
96-hr LC50s for three species = 6.7–240 μg/L[3]

Table 1—(Continued)

Pollutant Type of Information
Silver (Continued)
Avoidance tests with three carps[55]
4-hr EC50 = 100 µg/L for *Nitrobacter* and 30 µg/L for *Nitrosomonas*[167]
48-hr EC50s = 0.6–55 µg/L for *Daphnia magna*[323,336]
72-hr LC50 = 0.1 mg/L for carp and 0.047 mg/L for goldfish[588]
LC50s = 0.9–10.9 µg/L for three species; 0.1 and 4.1 µg/L were chronically toxic to rainbow trout and *Daphnia magna*, respectively[589]
Silvex (2,4,5-TP)
Concentrations in Texas fish[34]
Simazine
Review of effects on aquatic life[402]
1.0 mg/L affected periphyton community; recovery was rapid[590]
Sodium
Relationship of feeding habits to concentrations in insects[79]
Relationship of size to concentrations in insects[80]
Uptake by *Phoxinus phoxinus*[220]
Acute and chronic toxicity to *Daphnia magna*[403]
Sodium dodecyl sulfate (Sodium lauryl sulfate) (see also detergents)
96-hr LC50s = 6.2–30 mg/L for four fishes[18]
Toxicity to two green algae[71]
48-hr EC50 for *Daphnia magna* = 5.9–11.4 mg/L[556]
Space shuttle launch toxicants
Histological effects on mosquitofish and sailfin molly (*Poecilia latipinnna*)[591]
Streptomycin
Caused population shifts in microcosm[404]
Effects on microcosm under various conditions[593]
Strontium
Concentrations in six Canadian species[44]
Uptake by *Phoxinus phoxinus*[220]
Sulfate
Reduced adverse effects of fish hauling[592]
Sulfoxide
Effects on toxicity of four pesticides to a snail[201]
Sulfur
Concentrations in six Canadian species[44]
Concentrations in Canadian *Sphagnum magellanicum*[143]
Supersaturation
Lethality to rainbow trout[594]
Effects on swimming and quiescent carp and black bullhead (*Ictalurus melas*)[595]
Surfactants (see also detergents)
48-hr LC50 for *Daphnia magna* = 0.24 mg/L[19]
Effect on blood of *Clarias batrachus*[24]
Acute and chronic toxicity to several species[217,218]
Effect of water quality on toxicity to *Daphnia magna*[219]
48-hr LC50s for six invertebrates = 0.1–270 mg/L[596]
Toxicity to *Oryzias latipes*, *Daphnia carinata*, and *Bufo bufo japonicus*[597]
Effects on *Chlamydomonas reinhardii*[598]
2,4,5-T
Concentrations in Texas fishes[34]
40 mg/L reduced snail yield by 72%[599]
TFM (lampricide)
Presumed harmless concentration for a snail = 349 µg/L[83]
Taconite tailings
No effect on toxicity of endrin or cadmium to fathead minnow[180]
Temephos (Abate)
Adaptation by carp[200]
Induced invertebrate drift in a stream[352,600]
96-hr LC50 = 1.9 mg/L for guppy and 0.47 mg/L for *Sarotherodon galilaea*[601]
Terbutazine
Toxicity to common carp[103]
Terbutryn (Igran)
Toxicity to common carp[103]
Factors affecting bioavailability to plants and animals[283]
BCF = 90 with *Lemna minor*[296]
0.01 mg/L affected periphyton community; recovery was rapid[590]
Tetrachlorobenzenes
Concentrations in spottail shiner from Niagara River[22]
48-hr LC50 = 8 mmol/m^3 for *Daphnia magna*[73]
Tetrachlorocatechol
Toxicity to two plants[216]
Tetrachlorodibenzo-p-dioxins (TCDD)
Concentrations in various fishes[22,309,806]
0.1 ng/L affected rainbow trout and northern pike[602]
Uptake and depuration by rainbow trout and fathead minnow[604]
1,1,2,2-Tetrachloroethane
96-hr LC50 for fathead minnow = 20.3 mg/L[10,11]
Tetrachloroethylene
Concentrations in German fishes[150]
Food chain dynamics in Finnish lakes[213]
0.001 mL/L reduced 60-day growth and survival of *Poecilia sphenops*[232]
Tetrachlorophenols
96-hr LC50 and BCF for guppy[126]
Food chain dynamics in Finnish lakes[213]
Related to flavor impairment[365]
1,2,4,5-Tetramethylbenzene
48-hr LC50 = 3.5 mmol/m^3 for *Daphnia magna*[73]
Thiobencarb (Benthiocarb)
LC50 for *Sarotherodon mossambicus* = 9.5 mg/L; 3 mg/L affected metabolism[606]
Concentrations in Japanese fishes[607,608]
Thiodicarb (Larvin)
Effects on pond invertebrates[609]
Thiotox
Biochemical effects on *Mystus vittatus*[209]
30-day biochemical effects on three fishes[313]

(Table 1 Continued)

Table 1—(Continued)

Pollutant Type of Information
Thiram
96-hr LC50 for *Cloeon dipterum* = 0.39–1.01 mg/L[610]
96-hr LC50 for *Lymnaea stagnalis* = 3–35 mg/L[611]
Tin
3 500 μmol/L killed *Poterioochromonas malhamensis*[94]
Impaired hatch of common carp[178]
Tin, organo
80 μmol/L killed *Poterioochromonas malhamensis*[94]
Acute and chronic toxicity to *Daphnia magna*[403]
Toxicity to and uptake by carp[612]
Acute toxicity to three algae[613]
Titanium
Toxicity to 32 bacteria and *Daphnia magna*[43]
Concentrations in six Canadian species[44]
Toluene
Acute toxicity = 13–20 mg/L for *Daphnia magna* and fathead minnow[49]
48-hr LC50 = 125 mmol/m^3 for *Daphnia magna*[73]
Toxicity thresholds = 1 500 mmol/m^3 for two protozoa[112]
96-hr LC50 = 0.02 mg/L for rainbow trout[114]
Acute and chronic toxicity to fathead minnow[614]
Toxaphene
Uptake from wastewater by two fishes[32]
Effects on bluegill ATPases[33]
Concentrations in Texas fish[34]
Tribromoethene
Acute and chronic toxicity to three species[125]
Trichlorfon (Chlorphos, Chlorfos)
EC50 = 332 500 μg/L for *Chlamydomonas reinhardii*[16]
Avoidance tests with three carps[55]
24-hr LC50 for common carp = 8.8 mg/L[234]
Biochemical effects on two fishes[295]
Trichlorobenzenes
96-hr LC50 = 2.9 mg/L for fathead minnow[10,11]
Concentrations in spottail shiner from Niagara River[22]
48-hr LC50 = 15 mmol/m^3 for *Daphnia magna*[73]
Toxicity to various species[310]
Physiological effects on rainbow trout[470]
2,3,6-Trichlorobenzoic acid (2,3,6-TBA)
Review of effects on aquatic life[402]
3,4,5-Trichlorocatecol
Toxicity to two plants[216]
2,2,2-Trichloroethanol
96-hr LC50 = 300 mg/L for fathead minnow[10,11]
Trichloroethylenes
Susceptibilities of 22 species from bacteria through amphibians = 25–>1 000 mg/L[5]
48-hr LC50s for 15 macroinvertebrates = 24–132 mg/L[7]
Acute toxicity to six species[8]
96-hr LC50 = 44.1 mg/L for fathead minnow[10,11]
0.001 mL/L reduced 60-day growth and survival of *Poecilia sphenops*[232]

Pollutant Type of Information
4,5,6-Trichloroguaiacol
Toxicity to two plants[216]
Trichlorophenols
Effect of pH on acute toxicity and bioconcentration with guppy[126]
Toxicity to two plants[216]
Related to flavor impairment[365]
Tricyclazole
Toxicity to 14 species[110]
Triethylene glycol
48-hr LC50 for *Daphnia magna* = 35 000 μL/L; MATC = 5 500–11 000 μL/L[9]
96-hr LC50 = 69 800 mg/L for fathead minnow[10,11]
Trifluralin
Review of effects on aquatic life[402]
96-hr LC50 = 12 mg/L for fish and crayfish[489]
Caused vertebral deformation in brown trout[616]
Trimethylbenzenes
48-hr LC50 = 30–50 mmol/m^3 for *Daphnia magna*[73]
2,3,6-Trimethylphenol
Effect of pH on acute toxicity to guppy[126]
Trinitrobenzenes
Acute toxicity = 0.8–12 mg/L for *Daphnia magna* and fathead minnow[49]
Uranium
Toxicity to 32 bacteria and *Daphnia magna*[43]
Accumulation by a pond lily[618]
Urea
96-hr LC50 = 5.0 mg/L for *Colisa fasciatus*[619]
Vanadium
Concentrations in six Canadian species[44]
BCF = 2–28 with flagfish[620]
Vinclozolin
Toxicity to 14 species[110]
Wastewater treatment plant effluent
Chronic effects on fathead minnow[603]
Reduced toxicity of copper to coho salmon[608]
Effect on survival and growth of six fishes[621]
Caused oral papillomas on black bullhead[622]
Reduced diatom populations in Cladophora[623]
Affected benthic fauna populations[624]
Comparison of results of toxicity tests and field surveys[625]
Xylenes
48-hr LC50 = 30–80 mmol/m^3 for *Daphnia magna*[73]
Toxicity thresholds = 16.5–1 530 mmol/m^3 for two protozoa[112]
96-hr LC50 = 3.77 mg/L for rainbow trout[114]
Zinc
EC50 for *Pseudomonas fluoroscens* <0.02 mg/L[26]
Prior exposure increased LC50 for rainbow trout[27]
Concentrations in various fishes[29,133,144,153,294]
Toxicity to *Daphnia middendorffiana*[38]
Concentrations in six Canadian species[44]
Biochemical effects on rainbow trout[53]

Table 1—(Continued)

Pollutant Type of Information
Zinc (Continued)
Avoidance tests with three carps[55]
Influenced motility behavior of rainbow trout[59]
Toxicity to *Elodes densa*[65]
Reduced oxygen consumption of *Corbicula regularis*[69]
Concentrations in *Pacifastacus trowbridgi*[87]
Toxicity to algal communities[89,635]
Uptake by *Chlorella kessleri*[90]
Uptake by 20 algae[92]
Toxicity of a mixture to four algae[95]
Acute and chronic toxicity to rainbow trout[104]
Concentrations in European mosses[106,147]
Concentrations in *Rhynchostegium riparioides* in England[107]
Toxicity to and uptake by two algae[132]
Reduced phytoplankton productivity and abundance[136]
Toxicity to 87 species of Chlorophyta[139]
BCF with *Corbicula fluminea* = 358–631[140]
Concentrations in European *Fontinalis antipyretica*[141]
Concentrations in English invertebrates[142]
Concentrations in Canadian *Sphagnum magellanicum*[143]
LC50 for *Chlorella pyrenoidosa* = 13 mg/L[149]
Reduced stream flora[155]
96-hr EC50 = 10 mg/L for diatom *Navicula incerta*[163]
4-hr EC50 = 1 000 mg/L for Nitrobacter and 100 mg/L for Nitrosomonas[167]
Concentrations in river otters[168]
Possibly differentially affected caddisflies[169]
No accumulation by fathead minnow[172]
Affected sensitivity of white sucker to cadmium[173]
96-hr EC50 for *Chlorella saccharophila* = 7.1 mg/L[175]
96-hr LC50 for *Lymnaea acuminata* = 10.49 mg/L[177]
Impaired hatch of common carp[178]
Uptake by liverwort[191]
96-hr LC50 = 60.3 mg/L for *Channa punctatus*[194]
Uptake by two fishes in a lake[221]
With copper, effect on *Scenedesmus quadricauda*[254]
Correlations between concentrations in fish and toxicity[277]
BCF = 50 for *Gammarus aequicauda*[290]
Uptake by and effects on growth of *Chlamydomonas variabilis*[330]
Effect of pH and temperature on acute toxicity to *Channa punctatus*[378]
Hematological effects on rainbow trout[389]
Effects on lymphoid cells of common carp[440]
96-hr LC50 for *Ranatra elongata* = 1.7 mg/L[447]

[a] LC50 = median lethal concentration.
[b] NOEC = no observed effect concentration.
[c] MATC = maximum acceptable toxicant concentration.
[d] EC50 = median effective concentration.
[e] BCF = bioconcentration factor.

Gary L. Phipps, Mary J. Harden, Edward N. Leonard, Thomas H. Rouse, Diane L. Spehar, and Charles E. Stephan are with the Environmental Research Laboratory, Duluth, Minn. Quentin H. Pickering is with the Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, and Arthur L. Buikema, Jr., is with Virginia Polytechnic Institute and State University, Blacksburg, Va. Correspondence should be addressed to C. E. Stephan, Environmental Research Laboratory, Office of Research and Development, U.S. EPA, Duluth, MN 55804.

REFERENCES

1. Cairns, M. A., and Nebeker, A. V., "Toxicity of Acenaphthene and Isophorone to Early Life Stages of Fathead Minnows." *Arch. Environ. Contam. Toxicol.*, **11,** 703 (1982).
2. Bastian, M. V., and Toetz, D. W., "Effect of Eight Polynuclear Hydrocarbons on Growth of *Anabaena flos-aquae*." *Bull. Environ. Contam. Toxicol.*, **29,** 531 (1982).
3. Holcombe, G. W., *et al.*, "Toxicity of Selected Priority Pollutants to Various Aquatic Organisms." *Ecotoxicol. Environ. Saf.*, **7,** 400 (1983).
4. Vuorinen, P., "Acute Toxicity of the Slimecide Fennosan F 50 to Two Species of Trout and the Effect of Acetone on the Toxicity." *Finnish Fish. Res.*, **4,** 62 (1982).
5. Slooff, W., *et al.*, "Comparison of the Susceptibility of 22 Freshwater Species to 15 Chemical Compounds. I. (Sub)acute Toxicity Tests." *Aquat. Toxicol.*, **3,** 113 (1983).
6. Nishiuchi, Y., "Toxicity of Pesticides to Fresh Water Organisms. LXXVIII. Effects of Solvents Used for Dissolving Pesticides on the Toxicity Study." *Suisan Zoshoku*, **30,** 154 (1982); *C.A. Selects—Environ. Pollut.*, **21,** 99:117480s (1983).
7. Slooff, W., "Benthic Macroinvertebrates and Water Quality Assessment: Some Toxicological Considerations." *Aquat. Toxicol.*, **4,** 73 (1983).
8. Slooff, W., "A Comparative Study on the Short-Term Effects of 15 Chemicals on Fresh Water Organisms of Different Tropic Levels." (In Dutch), PB83–200386, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
9. LeBlanc, G. A., and Surprenant, D. C., "The Acute and Chronic Toxicity of Acetone, Dimethyl Formamide, and Triethylene Glycol to *Daphnia magna* (Straus)." *Arch. Environ. Contam. Toxicol.*, **12,** 305 (1983).
10. Veith, G. D., *et al.*, "Estimating the Acute Toxicity of Narcotic Industrial Chemicals to Fathead Minnows." In: "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 803, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 90 (1983).
11. Veith, G. D., *et al.*, "Structure-Toxicity Relationships for the Fathead Minnow, *Pimephales promelas*: Narcotic Industrial Chemicals." *Can. J. Fish. Aquat. Sci.*, **40,** 743 (1983).
12. Tonogai, Y., *et al.*, "Actual Survey of TL_m (Median Tolerance Limit) Values of Environmental Pollutants, Especially on Amines, Nitriles, Aromatic Nitrogen Compounds and Artificial Dyes." *J. Toxicol. Sci.*, **7,** 193 (1982).
13. Brown, L., *et al.*, "Qualitative and Quantitative Studies on the *In Situ* Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River." *Water Res.* (G. B.), **16,** 579 (1982).
14. Svobodova, Z., *et al.*, "Toxicity of Urea-Based Herbicides to Fish." *Agrochemia (Bratislava)* (Czech.), **23,** 109 (1983); *C.A. Selects—Environ. Pollut.*, **18,** 99:65542s (1983).
15. Hatanaka, J., *et al.*, "Usefulness and Rapidity of Screening for the Toxicity and Carcinogenicity of Chemicals in Medaka, *Oryzias latipes*." *Jpn. J. Exp. Med.*, **52,** 243 (1982).
16. Lee, E. K., and Hong, Y. N., "Studies on the Growth of Freshwater Algae by Biocides. I. On the Growth of *Chlamydomonas reinhardii*." *Sikmul Hakhoe Chi* (Korea), **25,** 113 (1982); *C.A. Selects—Environ. Pollut.*, **10,** 98:157691x (1983).
17. Schnoor, J. L., *et al.*, "Verification of a Toxic Organic Substance Transport and Bioaccumulation Model." PB83–170563, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
18. Newsome, C. S., "Susceptibility of Various Fish Species at Different Stages of Development to Aquatic Pollutants." In: "Environment and Quality of Life. Principles for the Interpretation of the Results of Testing Procedures in Ecotoxicology." EUR 7549, 284, Comm. Eur. Commun., Luxembourg, Belgium (1982).

19. Lewis, M. A., "Effect of Loading Density on the Acute Toxicities of Surfactants, Copper, and Phenol to *Daphnia magna* Straus." *Arch. Environ. Contam. Toxicol.*, **12**, 51 (1983).
20. Pickering, Q. H., and Gilliam, W. T., "Toxicity of Aldicarb and Fonofos to the Early-Life-Stage of the Fathead Minnow." *Arch. Environ. Contam. Toxicol.*, **11**, 699 (1982).
21. Gupta, A. K., and Dhillon, S. S., "The Effects of a Few Xenobiotics on Certain Phosphatases in the Plasma of *Clarias batrachus* and *Cirrhina mrigala*." *Toxicol. Lett.*, **15**, 181 (1983).
22. Suns, K., *et al.*, "Organochlorine Contaminant Residues in Spottail Shiners (*Notopis hudsonius*) from the Niagara River." *J. Great Lakes Res.*, **9**, 335 (1983).
23. Simmons, M. S., *et al.*, "A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish." *J. Great Lakes Res.*, **8**, 587 (1982).
24. Dhillon, S. S., and Gupta, A. K., "A Clinical Approach to Study the Pollutants Intoxication in a Freshwater Teleost *Clarias batrachus*." *Water, Air, Soil Pollut.*, **20**, 63 (1983).
25. Haines, T. A., "Organochlorine Residues in Brook Trout From Remote Lakes in the Northeastern United States." *Water, Air, Soil Pollut.*, **20**, 47 (1983).
26. Cherdyntseva, L. M., "Toxic Effect of Zinc on *Pseudomonas fluoresencs*." *Gidrobiol. Zh.* (USSR), **18**, 88 (1982).
27. Anadu, D. I., "Fish Accumulation and the Development of Tolerance to Zinc as a Modifying Factor in Toxicity." *Diss. Abstr. Int. B*, **44**, 1397 (1983).
28. Shukla, G. S., *et al.*, "Acute Toxicity of Few Pesticides to an Aquatic Insect, *Ranatra elongata* (Fabr.)." *J. Adv. Zool.*, **3**, 148 (1982).
29. Pennington, C. H., *et al.*, "Contaminant Levels in Fishes from Brown's Lake, Mississippi." *J. Miss. Acad. Sci.*, **27**, 139 (1982).
30. Hartley, D. M., and Johnston, J. B., "Use of the Freshwater Clam *Corbicula manilensis* as a Monitor for Organochlorine Pesticides." *Bull. Environ. Contam. Toxicol.*, **31**, 33 (1983).
31. Meier, P. G., *et al.*, "Organochlorine Pesticide Residues in Rice Paddies in Malaysia, 1981." *Bull. Environ. Contam. Toxicol.*, **30**, 351 (1983).
32. Henderson, S., "Evaluation of Filter Feeding Fishes for Removing Excessive Nutrients and Algae From Wastewater." PB83-193334, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
33. Hiltibran, R. C., "Effects of Insecticides on the Metal-Activated Hydrolysis of Adenosine Triphosphate by Bluegill Liver Mitrochondria." *Arch. Environ. Contam. Toxicol.*, **11**, 709 (1982).
34. Dick, M., "Pesticide and PCB Concentrations in Texas Water, Sediment, and Fish Tissue." Rept. No. 264, Texas Dept. Water Resour., Austin, Tex. (1982).
35. Nishimura, K., *et al.*, "Effect of Pyrethroids and DDT Analogs on the Frequency of Spontaneous Discharges in Crayfish Central Nerve Cord." *J. Pesticide Sci.*, **8**, 283 (1983).
36. Nishiuchi, Y., "Toxicity of Pesticides to Fresh Water Organisms. LXXXI. Effects of Pesticides on Tadpoles." *Suisan Zoshoka* (Jpn.), **30**, 167 (1982); *C.A. Selects—Environ. Pollut.*, **22**, 99:135148u (1983).
37. Baker, J. P., and Schofield, C. L., "Aluminum Toxicity to Fish in Acidic Waters." *Water, Air, Soil Pollut.*, **18**, 289 (1982).
38. Havas, M., and Hutchinson, T. C., "Aquatic Invertebrates From the Smoking Hills, N.W.T.: Effect of pH and Metals on Mortality." *Can. J. Fish. Aquat. Sci.*, **39**, 890 (1982).
39. Helliwell, S., *et al.*, "Speciation and Toxicity of Aluminum in a Model Fresh Water." *Environ. Technol. Lett.*, **4**, 141 (1983).
40. Brown, D. J. A., "Effect of Calcium and Aluminum Concentrations on the Survival of Brown Trout (*Salmo trutta*) at Low pH." *Bull. Environ. Contam. Toxicol.*, **30**, 582 (1983).
41. Ogilvie, D. M., and Stechey, D. M., "Effects of Aluminum on Respiratory Responses and Spontaneous Activity of Rainbow Trout, *Salmo gairdneri*." *Environ. Toxicol. Chem.*, **2**, 43 (1983).
42. Brown, T. E., *et al.*, "Report of a Large Fish Kill Resulting From Natural Acid Water Conditions in Australia." *J. Fish. Biol.*, **22**, 335 (1983).
43. Jakubczak, E., *et al.*, "Sensitivity of Bacteria in an Aquatic Environment to Some Toxic Substances." *Colloq. Inst. Natl. Sante Rech. Med.* (Fr.), **106**, 94 (1982); *C.A. Selects—Environ. Pollut.*, **6**, 98:84584c (1983).
44. Wren, C. D., *et al.*, "Examination of Bioaccumulation and Biomagnification of Metals in a Precambrian Shield Lake." *Water, Air, Soil Pollut.*, **19**, 277 (1983).
45. Buergel, P. M., and Soltero, R. A., "The Distribution and Accumulation of Aluminum in Rainbow Trout Following a Whole-Lake Alum Treatment." *J. Freshwater Ecol.*, **2**, 37 (1983).
46. Zahradnik, J., *et al.*, "Effect of Aminex on the Growth of *Chlorella vulgaris*." *Vodni Hospod.* (Czech.), **2B**, 53 (1983); *C.A. Selects—Environ. Pollut.*, **12**, 98:203998c (1983).
47. Corture, P., *et al.*, "Long and Short-Term Toxic Effects of Fenitrothion and Aminocarb on *Chlamydomonas variabilis* and *Selenastrum capricornutum*." *Eau Que.* (Fr.), **15**, 26 (1982); *Aquat. Sci. Fish. Abstr.*, **13**, 3992–1Q13 (1983).
48. Elner, J. K., *et al.*, "Carbon-14 Assimilation by Algal Communities of Oligotrophic Ponds Treated With Formulated Aminocarb." *Arch. Environ. Contam. Toxicol.*, **11**, 675 (1982).
49. Liu, D. H. W., *et al.*, "Toxicity of a Complex Munitions Wastewater to Aquatic Organisms." In: "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 135 (1983).
50. Bailey, H. C., and Spanggord, R. J., "The Relationship Between the Toxicity and Structure of Nitroaromatic Chemicals." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 98 (1983).
51. Hazel, R. H., *et al.*, "Development of Water Quality Criteria for Ammonia and Total Residual Chlorine for the Protection of Aquatic Life in Two Johnson County, Kansas, Streams." In "Aquatic Toxicology and Hazard Assessment: Fifth Conference." ASTM STP 766, J. G. Pearson, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 381 (1982).
52. Fava, J. A., *et al.*, "Evaluation of Ammonia Toxicity in Site-Specific Environmental Assessments." In "Land and Water Issues Related to Energy Development." P. J. Rand (Ed.), Ann Arbor Sci., Ann Arbor, Mich., 319 (1982).
53. Wagner, G. F., and McKeown, B. A., "Changes in Plasma Insulin and Carbohydrate Metabolism of Zinc-Stressed Rainbow Trout, *Salmo gairdneri*." *Can. J. Zool.*, **60**, 2079 (1982).
54. Paller, M. H., *et al.*, "Effects of ammonia and chlorine on fish in streams receiving secondary discharges." *J. Water Pollut. Control Fed.*, **55**, 1087 (1983).
55. Jiang, L., and Pan, B., "Avoidance Reaction of Fishes to Some Heavy Metals and Pesticides." *Huanjing Kexue* (China), **3**, 1 (1982); *C.A. Selects—Environ. Pollut.*, **6**, 98:84526k (1983).
56. Nemcsok, J., *et al.*, "Effect of Ammonia on Blood Glucose Level, GOT, GPT, LDH Enzyme Activity and Respiration of Three Fish Species." *Aquacult. Hung.*, **3**, 63 (1982).
57. Chatterjee, S., and Bhattacharya, S., "Ammonia-Induced Change in the Hepatic Glutathione Level of an Air-Breathing Freshwater Teleost *Channa punctatus* (Bloch)." *Toxicol. Lett.*, **17**, 329 (1983).
58. Alabaster, J. S., *et al.*, "The Acute Lethal Toxicity of Mixtures of Cyanide and Ammonia to Smolts of Salmon, *Salmo salar* L. at Low Concentrations of Dissolved Oxygen." *J. Fish Biol.*, **22**, 215 (1983).
59. Petry, H., "The Motility Test, an Early Warning System for the Biological Control of Waters." *Zentralbl. Bakteriol., Mikrobiol. Hyg., I Abt. B* (Den.), **176**, 391 (1982); *Aquat. Sci. Fish. Abstr.*, **13**, 2167–1Q13 (1983).
60. Mitchell, S. J., and Cech, J. J., Jr., "Ammonia-Caused Gill Damage in Channel Catfish (*Ictalurus punctatus*): Confounding Effects of Residual Chlorine." *Can. J. Fish. Aquat. Sci.*, **40**, 242 (1983).
61. Soderberg, R. W., *et al.*, "Effects of Ammonia on Growth and

Survival of Rainbow Trout in Intensive Static-Water Culture." *Trans. Am. Fish. Soc.*, **112,** 448 (1983).
62. Thurston, R. V., and Russo, R. C., "Acute Toxicity of Ammonia to Rainbow Trout." *Trans. Am. Fish. Soc.*, **112,** 696 (1983).
63. Thurston, R. V., *et al.*, "Acute Toxicity of Ammonia to Fathead Minnows." *Trans. Am. Fish. Soc.*, **112,** 705 (1983).
64. Kumar, N. J., and Krishnamoorthi, K. P., "Evaluation of Toxicity of Ammoniacal Fertiliser Effluents." *Environ. Pollut.* (G. B.), **30A,** 77 (1983).
65. Tokunaga, T., and Kishikawa, A., "Acute Visible and Invisible Injuries to Submerged Plants by Water Pollutants." *Seitai Kagaku* (Jpn.), **5,** 23 (1982); *C.A. Selects—Environ. Pollut.*, **21,** 97:121482v (1982).
66. Roseboom, D. P., "Discussion of: Evaluation of EPA un-ionized ammonia toxicity criteria." *J. Water Pollut. Control Fed.*, **55,** 420 (1983).
67. Szumski, D. S., "Discussion of: Evaluation of EPA un-ionized ammonia toxicity criteria." *J. Water Pollut. Control Fed.*, **55,** 420 (1983).
68. Swigert, J. P., and Spacie, A., "Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions." Tech. Rept. No. 157, Purdue Univ. Water Resour. Res. Cent., West Lafayette, Ind. (1983).
69. Lomte, V. W., and Jadhav, M. L., "Effects of Toxic Compounds on Oxygen Consumption in the Fresh Water Bivalve, *Corbicula regularis* (Prime, 1860)." *Comp. Physiol. Ecol.*, **7,** 31 (1982).
70. Calamari, D., *et al.*, "Estimating the Hazard of Eight Amines on Aquatic Life." In "Environment and Quality of Life. Principles for the Interpretation of the Results of Testing Procedures in Ecotoxicology." EUR 7549, 329, Comm. Eur. Commun., Luxembourg, Belgium (1982).
71. Norland, S., *et al.*, "Different Toxic Responses of the Green Algae *Chlamydomonas reinhardti* and *Dunaliella bioculata*." In "Environment and Quality of Life. Principles for the Interpretation of the Results of Testing Procedures in Ecotoxicology." EUR 7549, 342, Comm. Eur. Commun., Luxembourg, Belgium (1982).
72. National Research Council of Canada, "Chlorinated Phenols: Criteria for Environmental Quality." NRCC 18578, Ottawa, Canada (1982).
73. Bobra, A. M., *et al.*, "A Predictive Correlation for the Acute Toxicity of Hydrocarbons and Chlorinated Hydrocarbons to the Water Flea (*Daphnia magna*)." *Chemosphere*, **12,** 1121 (1983).
74. Bowling, J. W., *et al.*, "Acute Mortality of Anthracene-Contaminated Fish Exposed to Sunlight." *Aquat. Toxicol.*, **3,** 79 (1983).
75. McCarthy, J. F., "Role of Particulate Organic Matter in Decreasing Accumulation of Polynuclear Aromatic Hydrocarbons by *Daphnia magna*." *Arch. Environ. Contam. Toxicol.*, **12,** 559 (1983).
76. Spacie, A., *et al.*, "Uptake, Depuration, and Biotransformation of Anthracene and Benzo[a]pyrene in Bluegill Sunfish." *Ecotoxicol. Environ. Saf.*, **7,** 330 (1983).
77. Gerould, S., *et al.*, "Anthracene Bioconcentration and Biotransformation in Chironomids: Effects of Temperature and Concentration." *Environ. Pollut.*, **30A,** 175 (1983).
78. Linder, G., and Bergman, H., "Periodic Depuration of Anthracene Metabolites in Rainbow Trout." *J. Colo.-Wyo. Acad. Sci.*, **14,** 14 (1982); *Sports Fish. Abstr.*, **28,** 83–001900 (1983).
79. Smock, L. A., "The Influence of Feeding Habits on Whole-Body Metal Concentrations in Aquatic Insects." *Freshwater Biol.*, **13,** 301 (1983).
80. Smock, L. A., "Relationships Between Metal Concentrations and Organism Size in Aquatic Insects." *Freshwater Biol.*, **13,** 313 (1983).
81. Serns, S. L., and Hoff, M. H., "Effects of the Combined Use of Two Fish Toxicants, Antimycin-A and Rotenone, on the Zooplankton of a Northern Wisconsin Bog Lake." Res. Rept. No. 120, Wis. Dep. Natl. Resour., Woodruff, Wis. (1982).
82. Gilderhus, P. A., "Effects of an Aquatic Plant and Suspended Clay on the Activity of Fish Toxicants." *North Am. J. Fish. Manage.*, **2,** 301 (1982).
83. Gupta, P. K., and Durve, V. S., "Acute Toxicity of Piscicide Antimycin-A, Molluscicide Bayer-73 and Lampricide 3-Trifluoromethyl-4-nitrophenol (TFM) to the Snail *Viviparus bengalensis* L." *Arch. Hydrogiol.* (Ger.), **97,** 540 (1983).
84. Petrovic, I., *et al.*, "Determination of Arsenic in Muscles and Liver of Some Freshwater Fish." In "Recent Dev. Food Anal., Proc. Eur. Conf. Food Chem." W. Baltes, *et al.* (Eds.), 367, Verlag Chem., Weinheim, Germany; *C.A. Selects—Environ. Pollut.*, **3,** 98:33241f (1983).
85. Brayalovskaya, V. L., *et al.*, "Role of Higher Aquatic Vegetation in the Extraction of Arsenic from Natural Waters." *Okhrana Prirod. Vod Urala, Sverdlovsk* (USSR), **13,** 49 (1982); *C.A. Selects—Environ. Pollut.*, **14,** 99:10467r (1983).
86. Brooks, R. R., *et al.*, "Pollution by Arsenic in a Gold-Mining District in Nova Scotia." *Environ. Pollut.*, **4B,** 109 (1982).
87. Gordon, C. C., and Silverman, A. J., "A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT." PB83-236117, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
88. Whittle, D. M., and Fitzsimons, J. D., "The Influence of the Niagara River on Contaminant Burdens of Lake Ontario Biota." *J. Great Lakes Res.*, **9,** 295 (1983).
89. Wang, W., "An Algal Assay Technique for Aquatic Toxicants." PB82-262908, U. S. Dept. Commerce, Springfield, Va. (1982).
90. Stary, J., and Kratzer, K., "The Cumulation of Toxic Metals on Alga." *J. Environ. Anal. Chem.*, **12,** 65 (1982).
91. Pandey, K., and Shukla, J. P., "Deleterious Effects of Arsenic on the Growth of Fingerlings of a Freshwater Fish, *Colisa fasciatus* (Bl. & Sch.)." *Acta Pharmacol. Toxicol.*, **50,** 398 (1982).
92. Jennett, J. C., *et al.*, "Factors Influencing Metal Accumulation by Algae." PB83-149377, NTIS, U. S. Dept. of Commerce, Springfield, Va. (1982).
93. Shariatpanahi, M., *et al.*, "Uptake and Distribution of Sodium Arsenate by Bacterial Cells." In "Trace Substances in Environmental Health—XVI." D. D. Hemphill (Ed.), Univ. Missouri, Columbia, Mo., 170 (1982).
94. Roderer, G., "Biological Effects of Inorganic and Organic Compounds of Mercury, Lead, Tin, and Arsenic." In "Trace Substances in Environmental Health—XVI." D. D. Hemphill (Ed.), Univ. Missouri, Columbia, Mo., 137 (1982).
95. Wong, P. T. S., *et al.*, "Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals." *Chemosphere*, **11,** 367 (1982).
96. Sorensen, E. M. B., *et al.*, "Electron Probe X-ray Microanalysis of Arsenic Inclusions in Fish." *Arch. Environ. Contam. Toxicol.*, **11,** 469 (1982).
97. Stary, J., *et al.*, "The Cumulation of Chromium and Arsenic Species in Fish (*Poecilia reticulata*)." *Int. J. Environ. Anal. Chem.*, **12,** 253 (1982).
98. Woodhead, A. D., *et al.*, "The Effects of Chronic Exposure to Asbestos Fibers in the Amazon Molly *Poecilia formosa*." *Environ. Int.*, **9,** 173 (1983).
99. Gunkel, G., "Investigations of the Ecotoxicological Effect of a Herbicide in an Aquatic Model Ecosystem. I. Sublethal and Lethal Effects." *Arch. Hydrobiol. Suppl.* (Ger.), **65,** 235 (1983).
100. DeNoyelles, F., *et al.*, "The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States." *Ecology*, **63,** 1285 (1982).
101. Grenier, G., *et al.*, "Physiological Effects of Atrazine at Sublethal Doses on *Limna minor* L. VI. Influence on the Mainclasses of Phospholipids." *Physiol. Veg.*, **20,** 179 (1982); *Aquat. Sci. Fish. Abstr.*, **13,** 4057–1Q13 (1983).
102. Cox, H. W., Jr., "The Effect of 2,4-D Atrazine, and Diuron on Algal Physiology and Population Dynamics." *Diss. Abstr. Int. B*, **43,** 3903 (1983).
103. Marcoco, S., and Cusa, E., "Establishment of Maximum Levels of Toxic Substance Mixtures in Surface Waters." *Hidrotechnica*,

27, 206 (1982); *C.A. Selects—Environ. Pollut.*, **10**, 98:156386q (1983).

104. Cairns, M. A., *et al.*, "Use of Fish Ventilation Frequency to Estimate Chronically Safe Toxicant Concentrations." *Trans. Am. Fish. Soc.*, **111**, 70 (1982).
105. Belknap, W. R., and Togasaki, R. K., "The Effects of Cyanide and Azide on the Photoreduction of 3-Phosphoglycerate and Oxaloacetate by Wild Type and Two Reductive Pentose Phosphate Cycle Mutants of *Chlamydomonas reinhardtii*." *Plant Physiol.*, **70**, 469 (1982).
106. Wehr, J. D., and Whitton, B. A., "Accumulation of Heavy Metals by Aquatic Mosses. 3. Season Changes." *Hydrobiologia* (Den.), **100**, 285 (1983).
107. Wehr, J. D., and Whitton, B. A., "Accumulation of Heavy Metals by Aquatic Mosses. 2. *Rhynchostegium riparioides*." *Hydrobiologia* (Den.), **100**, 261 (1983).
108. Leung, T. S., *et al.*, "Toxicities of Two Herbicides (Basagran, Diquat) and an Algicide (Cutrin-Plus) to Mosquitofish *Gambusia affinis*." *Environ. Pollut.*, **30A**, 153 (1983).
109. Dawson, V. K., *et al.*, "Accumulation and Loss of 2',5-Dichloro-4'-nitrosalicylanilide (Bayer 73) by Fish: Laboratory Studies." Invest. Fish Control 90, U. S. Fish Wildl. Serv., U. S. Dept. Interior, LaCrosse, Wis. (1982).
110. Nishiuchi, Y., "Toxicity of Pesticides to Some Aquatic Animals. V. Acute Toxicity of Latest Registered Pesticides to Some Aquatic Animals." *Seitai Kagaku* (Jap.), **5**, 9 (1983); *C.A. Selects—Environ. Pollut.*, **12**, 98:193036w (1983).
111. Trucco, R. G., *et al.*, "Toxicity, Accumulation and Clearance of Aromatic Hydrocarbons in *Daphnia pulex*." *Environ. Pollut.*, **31A**, 191 (1983).
112. Rogerson, A., *et al.*, "Determination and Interpretation of Hydrocarbon Toxicity to Ciliate Protozoa." *Aquat. Toxicol.*, **3**, 215 (1983).
113. DeGraeve, G. M., *et al.*, "Effects of Naphthalene and Benzene on Fathead Minnows and Rainbow Trout." *Arch. Environ. Contam. Toxicol.*, **11**, 487 (1982).
114. Black, J. A., *et al.*, "The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians." PB82–224601, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
115. Hannah, J. B., *et al.*, "Benzo(a)pyrene-Induced Morphologic and Developmental Abnormalities in Rainbow Trout." *Arch. Environ. Contam. Toxicol.*, **11**, 727 (1982).
116. Fingerman, S. W., and Short, E. C., Jr., "Changes in Neurotransmitter Levels in Channel Catfish After Exposure to Benzo(a)pyrene, Naphthalene, and Aroclor 1254." *Bull. Environ. Contam. Toxicol.*, **30**, 147 (1983).
117. Fingerman, S. W., *et al.*, "Responses of Channel Catfish to Xenobiotics: Induction and Partial Characterization of a Mixed Function Oxygenase." *Arch. Environ. Contam. Toxicol.*, **12**, 195 (1983).
118. McKnight, D. M., *et al.*, "Effect of Retorted-Oil Shale Leachate on a Blue-Green Alga (*Anabaena flos-aquae*)." *Bull. Environ. Contam. Toxicol.*, **30**, 6 (1983).
119. Kirino, S., *et al.*, "Quantitative Structure-Activity Relationships of the Herbicidal N-Benzyl-2-bromo-3,3-dimethyl-butanamides." *J. Pestic. Sci.*, **8**, 309 (1983).
120. Vijverberg, H. P. M., *et al.*, "Structure-Related Effects of Pyrethroid Insecticides on the Lateral-Line Sense Organ and on Peripheral Nerves of the Clawed Frog, *Xenopus laevis*." *Pestic. Biochem. Physiol.*, **18**, 315 (1982).
121. Dill, D. C., *et al.*, "Comparison of the Toxicities of Biphenyl, Monochlorobiphenyl, and 2,2',4,4'-Tetrachlorobiphenyl to Fish and Daphnids." In: "Aquatic Toxicology and Hazard Assessment: Fifth Conference." ASTM STP 766, J. G. Pearson, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 245 (1982).
122. Baker, M. D., *et al.*, "Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga." *Chemosphere*, **12**, 35 (1983).
123. Alexander, H. C., *et al.*, "Dynamics of Bromide Uptake and Depuration by Fathead Minnows." *Trans. Am. Fish. Soc.*, **111**, 755 (1982).
124. Wilde, E. W., *et al.*, "Acute Toxicity of Chlorine and Bromine to Fathead Minnows and Bluegills." *Bull. Environ. Contam. Toxicol.*, **31**, 309 (1983).
125. Canton, J. H., and Wegman, R. C. C., "Studies on the Toxicity of Tribromoethene, Cyclohexene and Bromocyclohexane to Different Freshwater Organisms." *Water Res.* (G. B.), **17**, 743 (1983).
126. Saarikoski, J., and Viluksela, M., "Relation Between Physiochemical Properties of Phenols and Their Toxicity and Accumulation in Fish." *Ecotoxicol. Environ. Saf.*, **6**, 501 (1982).
127. Adams, W. J., *et al.*, "Field Comparison of Laboratory-Derived Acute and Chronic Toxicity Data." In: "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 367 (1983).
128. Suzuki, S., *et al.*, "Residues of Paddy Herbicides in Fish and Shellfish. IV. Residues of CNP Metabolites in Fish and Shellfish." *Shokuhin Eiseigaku Zasshi* (Jap.), **24**, 187 (1983); *C.A. Selects—Environ. Pollut.*, **18**, 99:65558b (1983).
129. Helwig, D. D., and Hora, M. E., "Polychlorinated Biphenyl, Mercury, and Cadmium Concentrations in Minnesota Snapping Turtles." *Bull. Environ. Contam. Toxicol.*, **30**, 186 (1983).
130. Koizumi, N., *et al.*, "Studies on the Accumulation and Transfer of Pollutants Through Food Chain. 4. Effect of Inorganic Salts on the Toxicity of Cadmium for Killifish." *Sagami Joshi Daigaku Kiyo* (Jpn.), **46**, 37 (1982); *C.A. Selects—Environ. Pollut.*, **17**, 99:48674u (1983).
131. Remacle, J., *et al.*, "Cadmium Fate in Bacterial Microcosms." *Water, Air, Soil Pollut.*, **18**, 455 (1982).
132. Nagy-Toth, F., and Barna, A., "Algal-Physiological Analysis of Some Metal-Polluted Waters." *Stud. Cercet. Biol., Ser. Biol. Veg.*, **34**, 134 (1982); *C.A. Selects—Environ. Pollut.*, **12**, 98:192930w (1983).
133. Kawamata, S., *et al.*, "Contents of Heavy Metals in Fishes in Nagano Prefecture." *Nagano-ken Eisei Kogai Kenkyusho Kenkyu Hokoku* (Jpn.), **5**, 30 (1982); *C.A. Selects—Environ. Pollut.*, **7**, 98:105850d (1983).
134. Saxena, A. B., *et al.*, "Studies on the Acute Toxicity of Copper, Mercury, and Cadmium to *Danio malabaricus* and *Puntius ticto*." *J. Environ. Sci. Health*, **17A**, 657 (1982).
135. Gill, T. S., and Pant, J. C., "Cadmium Toxicity: Inducement of Changes in Blood and Tissue Metabolites in Fish." *Toxicol. Lett.*, **18**, 195 (1983).
136. Sastry, K. V., and Subhadra, K., "Effect of Cadmium on Some Aspects of Carbohydrate Metabolism in a Freshwater Catfish *Heteropneustes fossilis*." *Toxicol. Lett.*, **14**, 45 (1982).
137. Woodworth, J., *et al.*, "The Production of Cadmium-Binding Protein in Three Species of Freshwater Fish." *Toxicol. Lett.*, **15**, 289 (1983).
138. Parker, J. I., *et al.*, "Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan." *J. Great Lakes Res.*, **8**, 520 (1982).
139. Foster, P. L., "Metal Resistances of Chlorophyta From Rivers Polluted by Heavy Metals." *Freshwater Biol.*, **12**, 41 (1982).
140. Graney, R. L., Jr., *et al.*, "Heavy Metal Indicator Potential of the Asiatic Clam (*Corbicula fluminea*) in Artificial Stream Systems." *Hydrobiologia* (Den.), **102**, 81 (1983).
141. Say, P. J., and Whitton, B. A., "Accumulation of Heavy Metals by Aquatic Mosses. 1. *Fontinalis antipyretica* Hedw." *Hydrobiologia* (Den.), **100**, 245 (1983).
142. Burrows, I. G., and Whitton, B. A., "Heavy Metals in Water, Sediments and Invertebrates From a Metal-Contaminated River Free of Organic Pollution." *Hydrobiologia* (Den.), **106**, 263 (1983).
143. Percy, K. E., "Heavy Metal and Sulphur Concentrations in *Sphagnum magellanicum* Brid. in the Maritime Provinces, Canada." *Water, Air, Soil Pollut.*, **19**, 341 (1983).
144. Paul, A. C., and Pillai, K. C., "Trace Metals in a Tropical River

Environment—Speciation and Biological Transfer." *Water, Air, Soil Pollut.*, **19,** 75 (1983).
145. Sastry, K. V., and Subhadra, K., "Cadmium Induced Alterations in the Intestinal Absorption of Glucose and Fructose in a Freshwater Catfish, *Heteropneustes fossilis*." *Water, Air, Soil Pollut.*, **20,** 293 (1983).
146. Santiago-Fandino, V. J. R., "The Effects of Nickel and Cadmium on the Growth Rate of *Hydro littoralis* and an Assessment of the Rate of Uptake of ^{63}Ni and ^{14}C by the Same Organism." *Water Res.* (G. B.), **17,** 917 (1983).
147. Wehr, J. D., *et al.*, "Methods for Processing Aquatic Mosses Used as Monitors of Heavy Metals." *Water Res.* (G. B.), **17,** 985 (1983).
148. Ingersoll, C. G., and Winner, R. W., "Effect on *Daphnia pulex* (de Geer) of Daily Pulse Exposures to Copper or Cadmium." *Environ. Toxicol. Chem.*, **1,** 321 (1982).
149. Brauwers, C., "Comparison of Zn and Cd Toxicity on *Chorella pyrenoidosa*." *Bull. Soc. R. Bot. Belg.*, **115,** 78 (1982); *Aquat. Sci. Fish. Abstr.*, **13,** 7167–1Q13 (1983).
150. Binnemann, P. H., *et al.*, "Contents of Heavy Metals, Organochlorine Pesticides, PCB and Volatile Halogenated Hydrocarbons in Fish From the Upper Regions of the Rhine River, Between Strassburg and Lake Constance." *Z. Lebensm.-Unters. Forsch.* (Ger.), **176,** 253 (1983); *C.A. Selects—Environ. Pollut.*, **13,** 98:214294w (1983).
151. Foster, P. K., and Morel, F. M. M., "Reversal of Cadmium Toxicity in a Diatom: An Interaction Between Cadmium Activity and Iron." *Limnol. Oceanogr.*, **27,** 745 (1982).
152. Laegreid, M., *et al.*, "Seasonal Variation of Cadmium Toxicity Toward the Alga *Selenastrum capricornutum* Printz in Two Lakes With Different Humus Content." *Environ. Sci. Technol.*, **17,** 357 (1983).
153. Ney, J. J., *et al.*, "Patterns of Bioaccumulation of Heavy Metals in Stream Fishes." *Va. J. Sci.*, **33,** 116 (1982).
154. Babich, H., and Stotzky, G., "Influence of Chloride Ions on the Toxicity of Cadmium to Fungi." *Zentralbl. Bakteriol., Mikrobiol. Hyg., Abt. 1, Orig. C* (Ger.), **3,** 421 (1982).
155. Say, P. J., and Whitton, B. A., "Chemistry and Plant Ecology of Zinc-Rich Streams in France." *Ann. Limnol.*, **18,** 3 (1982).
156. Vanderborght, O. L. J., *et al.*, "Cadmium-Selenium Tests on Two Freshwater Organisms, a Pulmonate Snail and an Unicellular Green Alga." *Colloq.-Inst. Natl. Sante Rech. Med.*, **106,** 245 (1982).
157. Muramoto, S., "Elimination of Copper From Copper-Contaminated Fish by Long-Term Exposure to EDTA and Fresh Water." *Ber. Ohara Inst. Landwirtsch. Biol., Okayama Univ.*, **18,** 93 (1982).
158. Jana, S., and Choudhuri, M. A., "Senescence in Submerged Aquatic Angiosperms: Effects of Heavy Metals." *New Phytol.*, **90,** 477 (1982).
159. Sommer, C., and Winkler, S., "The Effect of Heavy Metals on the Rates of Photosynthesis and Respiration of *Fontinalis antipyretica* Hedw." *Arch. Hydrobiol.* (Ger.), **93,** 503 (1982).
160. Seyfried, P. L., and Horgan, C. B. L., "Effect of Cadmium on Lake Water Bacteria as Determined by the Luciferase Assay of Adenosine Triphosphate." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 425 (1983).
161. Tishinova-Nanova, V. I., "The Effect of Cadmium Ions on Some Cytochemical Reactions in Carp (*Cyprinus carpio* L.) Leucocytes." *Hydrobiology*, **18,** 35 (1983).
162. Colborn, T., "Aquatic Insects as Measured of Trace Element Presence in Water: Cadmium and Molybdenum." In "Aquatic Toxicology and Hazard Assessment: Fifth Conference." ASTM STP 766, J. G. Pearson, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 316 (1982).
163. Rachlin, J. W., *et al.*, "The Growth Response of the Diatom *Navicula incerta* to Selected Concentrations of the Metals: Cadmium, Copper, Lead and Zinc." *Bull. Torrey Bot. Club*, **110,** 217 (1983).
164. Fujii, K., and Sugiyama, M., "Toxic Effect of Cadmium to Early Life Stages of Fishes and a Simple Method for Toxicity Evaluation of Environmental Pollutants." *Seitai Kagaku* (Jpn.), **6,** 9 (1983).
165. Shah, P. H., and Dubale, M. S., "Retention of Cadmium in a Freshwater Fish, *Channa punctatus*." *Experientia* (Switz.), **39,** 522 (1983).
166. Yamamura, M., *et al.*, "Cadmium Uptake and Induction of Cadmium-Binding Protein in the Waterflea (*Moina macrocopa*)." *Bull. Environ. Contam. Toxicol.*, **30,** 298 (1983).
167. Williamson, K. J., and Nelson, P. O., "Bacterial Bioassay for Level I Toxicity Assessment." PB83–182287, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
168. Anderson-Bledsoe, K. L., and Scanlon, P. F., "Heavy Metal Concentrations in Tissues of Virginia River Otters." *Bull. Environ. Contam. Toxicol.*, **30,** 442 (1983).
169. Zanella, E. F., "Shifts in Caddisfly Species Composition in Sacramento River Invertebrate Communities in the Presence of Heavy Metal Contamination." *Bull. Environ. Contam. Toxicol.*, **29,** 306 (1982).
170. Taylor, D., "A Review of the Lethal and Sublethal Effects of Cadmium on Aquatic Life." In "Ed. Proc.—Int. Cadmium Conf., 3rd." D. Wilson and R. A. Volpe (Eds.), Cadmium Assoc., London, U. K., 75 (1982); *C.A. Selects—Environ. Pollut.*, **4,** 98:48015j (1983).
171. Knight, R. L., "Energy Model of a Cadmium Stream with Correlation of Embodied Energy and Toxicity." PB82–256876, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
172. Birge, W. J., *et al.*, "Induction of Tolerance to Heavy Metals in Natural and Laboratory Populations of Fish." PB84–111756, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
173. Duncan, D. A., and Klaverkamp, J. F., "Tolerance and Resistance to Cadmium in White Suckers (*Catostomus commersoni*) Previously Exposed to Cadmium, Mercury, Zinc, or Selenium." *Can. J. Fish. Aquat. Sci.*, **40,** 128 (1983).
174. Nasu, Y., *et al.*, "Comparative Studies on the Absorption of Cadmium and Copper in *Lemna paucicostata*." *Environ. Pollut.*, **32A,** 201 (1983).
175. Rachlin, J. W., *et al.*, "The Growth Response of the Green Alga (*Chlorella saccharophila*) to Selected Concentrations of the Heavy Metals Cd, Cu, Pb, and Zn." In "Trace Substances in Environmental Health-XVI." Hemphill, D. D. (Ed.), Univ. Missouri, Columbia, Mo., 145 (1982).
176. Dickson, G. W., *et al.*, "The Effect of Chronic Cadmium Exposure on Phosphoadenylate Concentrations and Adenylate Energy Charge of Gills and Dorsal Muscle Tissue of Crayfish." *Environ. Toxicol. Chem.*, **1,** 147 (1982).
177. Khangarot, B. S., *et al.*, "Comparative Toxicity of Heavy Metals and Interaction of Metals on a Freshwater Pulmonate Snail *Lymnaea acuminata* (Lamarck)." *Acta Hydrochim. Hydrobiol.*, **10,** 367 (1982).
178. Kapur, K., and Yadav, N. A., "The Effects of Certain Heavy Metal Salts on the Development of Eggs in Common Carp, *Cyprinus carpio* var. *communis*." *Acta Hydrochim. Hydrobiol.*, **10,** 517 (1982).
179. Francis, P. C., "Toxicological Significance of Sediment/Metal Interactions." *Diss. Abstr. Int. B*, **43,** 3904 (1983).
180. Carlson, A. R., *et al.*, "Cadmium and Endrin Toxicity to Fish in Waters Containing Mineral Fibers." PB82–225038, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
181. Sedlacek, J., *et al.*, "Effect of Aquatic Humus on Uptake and Toxicity of Cadmium to *Selenastrum capricornutum* Printz." In "Aquatic and Terrestrial Humic Materials." R. F. Christman, and E. T. Gjessing (Eds.), Ann Arbor Sci., Ann Arbor, Mich., 495 (1983).
182. Marion, M., and Denizeau, F., "Rainbow Trout and Human Cells in Culture for the Evaluation of the Toxicity of Aquatic Pollutants: A Study With Cadmium." *Aquat. Toxicol.*, **3,** 329 (1983).
183. Woodworth, J., and Pascoe, D., "Induction of Cadmium-Binding Protein in the Three-Spined Stickleback." *Aquat. Toxicol.*, **3,** 141 (1983).
184. Peterson, R. H., *et al.*, "Effects of Cadmium in Yolk Utilization,

Growth, and Survival of Atlantic Salmon Alevins and Newly Feeding Fry." *Arch. Environ. Contam. Toxicol.*, **12,** 37 (1983).

185. Takeda, H., *et al.*, "The Induction of Hepatic Metallothionein in Fish by Cadmium Administration." *Miyazaki Daigaku Nogakubu, Kenkyu Hokoku* (Jpn.), **29,** 161 (1982); *C.A. Selects—Environ. Pollut.*, **5,** 98:66759j (1983).
186. Yamamoto, Y., *et al.*, "Temperature Effect on the Cadmium Accumulation in *Oryzias latipes.* Special Reference to Dead Fish." *Seitai Kagaku* (Jpn.), **5,** 15 (1982); *C.A. Selects—Environ. Pollut.*, **25,** 97:176424h (1982).
187. Zinn, L. L., "The Effects of Cadmium and Naphthalene on Osmoregulatory Transport in the Opercular Epithelium of the Channel Catfish, *Ictalurus punctatus.*" *Diss. Abstr. Int. B,* **43,** 3177 (1983).
188. Fujii, K., and Sugiyama, M., "Toxic Effect of Cadmium to Early Life Stages of Fishes and a Simple Method for Toxicity Evaluation of Environmental Pollutants." *Seitai Kagaku* (Jpn.), **6,** 9 (1983); *C.A. Selects—Environ. Pollut.*, **22,** 99:134995f (1983).
189. Heisinger, J. F., "Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos." PB82-256645, NTIS, U. S. Dept. Commerce, Springfield, Va. (1981).
190. Zauke, G. P., "Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser—II." *Water Res.* (G. B.), **16,** 785 (1982).
191. Whitton, B. A., *et al.*, "Accumulation of Zinc, Cadmium and Lead by the Aquatic Liverwort *Scapania.*" *Environ. Pollut.*, **3B,** 299 (1982).
192. Khummongkol, D., *et al.*, "Accumulation of Heavy Metals in Unicellular Algae." *Biotechnol. Bioeng.*, **24,** 2643 (1982).
193. Thomas, D. G., *et al.*, "Environmental Cadmium is not Sequestered by Metallothionein in Rainbow Trout." *Biochem. Biophys. Res. Commun.*, **110,** 584 (1983).
194. Saxena, O. P., and Parashari, A., "Comparative Study of the Toxicity of Six Heavy Metals to *Channa punctatus.*" *J. Environ. Biol.*, **4,** 91 (1983).
195. Yamamura, M., and Suzuki, K., "Characteristics of Metallothioneins Induced in the Fish *Carassius auratus langsdorfi.*" *Eisei Kagaku* (Jpn.), **29,** 100 (1983); *C.A. Selects—Environ. Pollut.*, **20,** 99:102522h (1983).
196. Stromberg, P. C., *et al.*, "Pathology of Lethal and Sublethal Exposure of Fathead Minnows, *Pimephales promelas,* to Cadmium: A Model for Aquatic Toxicity Assessment." *J. Toxicol. Environ. Health,* **11,** 247 (1983).
197. Mitani, H., "Lethal and Mutagenic Effects of Radiation and Chemicals on Cultured Fish Cells Derived From the Erythrophoroma of Goldfish (*Carassius auratus*)." *Mutat. Res.*, **107,** 279 (1983).
198. Prabhuji, S. K., *et al.*, "1,3,7-Trimethylxanthine (Caffeine); A New Natural Fish Fungicide." *Experientia* (Switz.), **39,** 177 (1983).
199. Sasayama, Y., *et al.*, "Effects of Environmental Mg and Ca Levels on the Serum Mg and Ca Concentr..ions in Tadpoles and Frogs." *Comp. Biochem. Physiol., A,* **74,** 577 (1983).
200. Popova, G. V., "Adaptive Reactions of Fish to the Effects of Pesticides." In "Reakts. Gidrobiontov Zagryaz." N. S. Stroganov (Ed.), 99, Izd. Nauka, Moscow, USSR (1983); *C.A. Selects—Environ. Pollut.*, **22,** 99:135134m (1983).
201. Singh, D. K., and Agarwal, R. A., "*In Vivo* and *In Vitro* Studies on Synergism With Anticholinesterase Pesticides in the Snail *Lymnaea acuminata.*" *Arch. Environ. Contam. Toxicol.*, **12,** 483 (1983).
202. Marian, M. P., *et al.*, "Acute and Chronic Effects of Carbaryl on Survival, Growth, and Metamorphosis in the Bullfrog (*Rana tigrina*)." *Arch. Environ. Contam. Toxicol.*, **12,** 271 (1983).
203. Basha, S. M., *et al.*, "Differential Toxicity of Malathion, BHC, and Carbaryl to the Freshwater Fish, *Tilapia mossambica* (Peters)." *Bull. Environ. Contam. Toxicol.*, **31,** 543 (1983).
204. Sastry, K. V., and Siddiqui, A. A., "Chronic Toxic Effects of the Carbamate Pesticide Sevin on Carbohydrate Metabolism in a Freshwater Snakehead Fish, *Channa punctatus.*" *Toxicol. Lett.*, **14,** 123 (1982).
205. Seuge, J., and Bluzat, R., "Chronic Toxicity of Three Insecticides (Carbaryl, Fenthion and Lindane) in the Freshwater Snail *Lymnaea stagnalis.*" *Hydrobiologia* (Den.), **106,** 65 (1983).
206. Wilder, I. B., and Stanley, J. G., "RNA-DNA Ratio as an Index to Growth in Salmonid Fishes in the Laboratory and in Streams Contaminated by Carbaryl." *J. Fish Biol.*, **22,** 165 (1983).
207. Gillet, C., and Roubaud, P., "Prehatching Survival of Carp Eggs After Treatment During Fertilization and Early Development With the Antimitotic Fungicide Carbendazim." *Water Res.* (G. B.), (Fr.), **17,** 1343 (1983).
208. Chatterjee, S., *et al.*, "*In Vivo* and *In Vitro* Activation of Peroxidase in the Head Kidney of *Channa punctatus* (Bloch) by Sublethal Doses of Carbofuran." *Comp. Physiol. Ecol.*, **7,** 129 (1982).
209. Verma, S. R., *et al.*, "Pesticides Combination Affecting Three Phosphatases in Certain Tissues of a Fish *Mystus vittatus.*" *J. Environ. Biol.*, **3,** 11 (1982).
210. Bakthavathsalam, R., and Reddy, Y. S., "Changes in the Content of Glycogen and Its Metabolites During Acute Exposure of *Anabas testudineus* (Bloch) to Furadan." *J. Biosci.*, **4,** 19 (1982).
211. Jash, N. B., *et al.*, "Role of Acetylcholine in the Recovery of Brain Acetylcholinesterase in *Channa punctatus* (Bloch) Exposed to Furadan." *Comp. Physiol. Ecol.*, **7,** 56 (1982).
212. Pawar, K. R., and Katdare, M., "Acute Toxicity of Sumithion, BHC and Furadan to Some Selected Freshwater Organisms." *Biovigyanam,* **9,** 67 (1983).
213. Paasivirta, J., *et al.*, "Food Chain Enrichment of Organochlorine Compounds and Mercury in Clean and Polluted Lakes of Finland." *Chemosphere,* **12,** 239 (1983).
214. Qadri, S., *et al.*, "Selective Toxicity of Organophosphorous and Carbamate Pesticides to Honeybee and Freshwater Fish." *Int. Pest Control,* **24,** 124 (1982).
215. Mustafa, M., *et al.*, "A Technique to Evaluate Acute Toxicity of Insecticide (Technical and Formulation) to Freshwater Fish, *Tilapia mossambica.*" *Int. Pest Control,* **24,** 90 (1982).
216. Rowe, E. L., *et al.*, "The Use of an Alga *Chlorella pyrenoidosa* and a Duckweed *Lemna perpusilla* as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components." *Environ. Pollut.*, **27A,** 289 (1982).
217. Lewis, M. A., and Wee, V. T., "Aquatic Safety Assessment for Cationic Surfactants." *Environ. Toxicol. Chem.*, **2,** 105 (1983).
218. Kappeler, T. U., "Aquatic Toxicity of Distearyldimethylammonium Chloride (DSDMAC)." *Tenside Deterg.* (Ger.), **19,** 169 (1982); *C.A. Selects—Environ. Pollut.*, **17,** 97:50796n (1982).
219. Waters, J., "Addendum to the Paper on, The Aquatic Toxicology of DSDMAC and Its Ecological Significance." *Tenside Deterg.* (Ger.), **19,** 177 (1982).
220. Buyanov, N. I., *et al.*, "Absorption and Excretion of Synthetic Radionuclides by Freshwater Fish." *Ekologiya (Sverdlovsk)* (USSR), **4,** 35 (1983); *C.A. Selects—Environ. Pollut.*, **22,** 99:136166k (1983).
221. Klaverkamp, J. F., *et al.*, "Fates of Metal Radiotracers Added to a Whole Lake: Accumulation in Slimy Sculpin (*Cottus cognatus*) and White Sucker (*Catostomus commersoni*)." *Sci. Total Environ.*, **28,** 119 (1983).
222. Ribick, M. A., and Zajick, J., "Gas Chromatographic and Mass Spectrometric Identification of Chlordane Components in Fish From Manoa Stream, Hawaii." *Chemosphere,* **12,** 1229 (1983).
223. Pyysalo, H., *et al.*, "A Baseline Study on the Concentrations of Chlordane-, PCB- and DDT-Compounds in Finnish Fish Samples in the Year 1982." *Chemosphere,* **12,** 837 (1983).
224. Davis, K. B., *et al.*, "Plasma Corticosteroids and Chlorides in Striped Bass Exposed to Tricaine Methanesulfonate, Quinaldine, Etomidate, and Salt." *Prog. Fish Cult.*, **44,** 205 (1982).
225. Schwedler, T. E., and Tucker, C. S., "Empirical Relationship Between Percent Methemoglobin in Channel Catfish and Dissolved Nitrite and Chloride in Ponds." *Trans. Am. Fish. Soc.*, **112,** 117 (1983).

226. Newbry, B. W., *et al.*, "Studies on the Water Quality Hazard of Chlorine in Domestic Wastewater Treatment Plant Effluents." In "Water Chlorination: Environmental Impact and Health Effects, Vol. 4, Book 2." R. L. Jolley, *et al.* (Eds.), Ann Arbor Sci., Ann Arbor, Mich., 1423 (1983).
227. Anderson, D. R., "Chlorine-Heavy Metals Interaction on Toxicity and Metal Accumulation." In "Water Chlorination: Environmental Impact and Health Effects, Vol. 4, Book 2." R. L. Jolley, *et al.* (Eds.), Ann Arbor Sci., Ann Arbor, Mich., 811 (1983).
228. Clark, J. R., *et al.*, "Food Quality of Aufwuchs From Artificial Streams Receiving Low Levels of Perturbations." *Water Resour. Bull.*, **18,** 761 (1982).
229. Murray, S. A., "Hematological Responses of Bluegill to Chlorination and Temperature Tests and to an Operating Power Plant." In "Water Chlorination: Environmental Impact and Health Effects, Vol. 4, Book 2." R. L. Jolley, *et al.* (Eds.), Ann Arbor Sci., Ann Arbor, Mich., 993 (1983).
230. Turner, A., and Chu, A., "Chlorine Toxicity as a Function of Environmental Variables and Species Tolerance." In "Water Chlorination: Environmental Impact and Health Effects, Vol. 4, Book 2." R. L. Jolley, *et al.* (Eds.), Ann Arbor Sci., Ann Arbor, Mich., 927 (1983).
231. Wilde, E. W., *et al.*, "Comparison of Chlorine and Chlorine Dioxide Toxicity to Fathead Minnows and Bluegill." *Water Res.* (G. B.), **17,** 1237 (1983).
232. Loekle, D. M., *et al.*, "Effects of Chloroform, Tetrachloroethylene, and Trichloroethylene on Survival, Growth, and Liver of *Poecilia sphenops.*" *Bull. Environ. Contam. Toxicol.*, **30,** 199 (1983).
233. Schauerte, W., *et al.*, "Long-Term Fate of Organochlorine Xenobiotics in Aquatic Ecosystems." *Ecotoxicol. Environ. Saf.*, **6,** 560 (1982).
234. Hashimoto, Y., *et al.*, "Changes in Susceptibility of Carp to Several Pesticides With Growth." *J. Pestic. Sci.*, **7,** 457 (1982).
235. Layiwola, P. J., *et al.*, "The Biotransformation of Three ^{14}C-Labelled Phenolic Compounds in Twelve Species of Freshwater Fish." *Xenobiotics,* **13,** 107 (1983).
236. Jarvinen, A. W., *et al.*, "Chronic Toxicity of Dursban (Chlorpyrifos) to the Fathead Minnow (*Pimpehales promelas*) and the Resultant Acetylcholinesterase Inhibition." *Ecotoxicol. Environ. Saf.*, **7,** 423 (1983).
237. Batac-Catalan, Z., and White, D. S., "Effect of Chromium on Larval Chironomidae as Determined by the Optical-Fiber Light-Interruption Biomonitoring System." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ATSM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 469 (1983).
238. Putte, I., *et al.*, "Effects of Hexavalent Chromium in Rainbow Trout (*Salmo gairdneri*) After Prolonged Exposure at Two Different pH Levels." *Ecotoxicol. Environ. Saf.*, **6,** 246 (1982).
239. Sastry, K. V., and Sunita, K., "Enzymological and Biochemical Changes Produced by Chronic Chromium Exposure in a Teleost Fish, *Channa punctatus.*" *Toxicol. Lett.*, **16,** 9 (1983).
240. Temmink, J. H. M., *et al.*, "An Ultrastructural Study of Chromate-Induced Hyperplasia in the Gill of Rainbow Trout (*Salmo gairdneri*)." *Aquat. Toxicol.*, **4,** 165 (1983).
241. Peres, G., and Brichon, M. H., "Comparative Study by the Mean of a Static Test (AFNOR) of the Relative Sensitivity of Several Species of Fish to Potassium Dichromate: *Brachydanio rerio.*" EUR 7549, Comm. Eur. Commun., Luxembourg, Belgium (1982); *C.A. Selects—Environ. Pollut.*, **25,** 97:194249j (1982).
242. Fasula, M. P., *et al.*, "Cytotoxic Effects of Hexavalent Chromium in *Euglena gracilis.* II. Physiological and Ultrastructural Studies." *Protoplasma,* **114,** 35 (1983).
243. Muller, H. G., "The Influence of the Water Composition and the Food Quality on Ecotoxicological Tests With *Daphnia magna.*" In "Environment and Quality of Life. Principles for the Interpretation of the Results of Testing Procedures in Ecotoxicology." EUR 7549, Comm. Eur. Commun., Luxembourg, Belgium (1982).
244. Murti, R., *et al.*, "Chromium Toxicity to a Freshwater Prawn *Macrobrachium lamarrei* (H. M. Edwards)." *Toxicol. Lett.*, **18,** 257 (1983).
245. Karpevich, A. F., "Adaptability and Plasticity of Aquatic Organisms." In "Reakts. Gidrobiontov Zagryaz." N. S. Stroganov (Ed.), 13, Izd. Nauka, Moscow, USSR (1983); *C.A. Selects—Environ. Pollut.*, **22,** 99:145721q (1983).
246. Dauble, D. D., *et al.*, "Effects of Coal Liquid Water-Soluble Fractions on Growth and Survival of Four Aquatic Organisms." *Arch. Environ. Contam. Toxicol.*, **11,** 553 (1982).
247. Dauble, D. D., *et al.*, "Retention and Toxicity of a Coal Liquid in Artificial Contaminated Sediments." *Water, Air, Soil Pollut.*, **20,** 391 (1983).
248. Gray, R. H., *et al.*, "Chemical Characteristics and Acute Toxicity of Sequentially Extracted Water-Soluble Fractions of a Coal Liquid." *Environ. Pollut.*, **32A,** 79 (1983).
249. Becker, C. D., *et al.*, "Acute Toxicity of Water Soluble Fractions Derived From a Coal Liquid (SCR-II) to Three Aquatic Organisms." *Water, Air, Soil Pollut.*, **19,** 171 (1983).
250. Dauble, D. D., *et al.*, "Chronic Effects of Coal-Liquid Dispersions on Fathead Minnows and Rainbow Trout." *Trans. Am. Fish. Soc.*, **112,** 712 (1983).
251. Giddings, J. M., *et al.*, "An Efficient Algal Bioassay Based on Short-Term Photosynthetic Response." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 45 (1983).
252. Sharma, M. L., *et al.*, "Haematological and Biochemical Characteristics of *Heteropneustes fossilis* Under the Stress of Congo Red (Diphenyl Disazo Binaphthionic Acid.)" *Toxicol. Lett.*, **14,** 237 (1982).
253. Borgmann, U., and Ralph, K. M., "Complexation and Toxicity of Copper and the Free Metal Bioassay Technique." *Water Res.* (G. B.), **17,** 1697 (1983).
254. Petersen, R., "Influence of Copper and Zinc on the Growth of a Freshwater Alga, *Scenedesmus quadricauda:* The Significance of Chemical Speciation." *Environ. Sci. Technol.*, **16,** 443 (1982).
255. Muramoto, S., "Elimination of Copper From Cu-Contaminated Fish by Long-Term Exposure to EDTA and Fresh Water." *J. Environ. Sci. Health,* **18A,** 455 (1983).
256. Foster, P. L., "Species Associations and Metal Contents of Algae From Rivers Polluted by Heavy Metals." *Freshwater Biol.*, **12,** 17 (1982).
257. Cote, R., "Toxic Effects of Copper on the Biomass and Productivity of the Phytoplankton of the Saguenay River, Quebec, Canada." *Hydrobiologia* (Den.), **98,** 85 (1983).
258. Babu, G. R., and Rao, P. V., "Heavy Metal Ion Toxicity in the Freshwater Gastropod Snail Host, *Lymnaea luteola.*" *Indian J. Physiol. Pharmacol.*, **26,** 141 (1982).
259. Dunn, G. M., and Bull, A. T., "Bioaccumulation of Copper by a Defined Community of Activated Sludge Bacteria." *Eur. J. Appl. Microbiol. Biotechnol.*, **17,** 30 (1983).
260. Sicko-Goad, L., "A Morphometric Analysis of Algal Response to Low Dose, Short-Term Heavy Metal Exposure." *Protoplasma,* **110,** 75 (1982).
261. Heisey, R. M., and Damman, A. W. H., "Copper and Lead Uptake by Aquatic Macrophytes in Eastern Connecticut, U. S. A." *Aquat. Bot.*, **14,** 213 (1982).
262. Buikema, A. L., Jr., *et al.*, "Correlation Between the Autotrophic Index and Protozoan Colonization Rates as Indicators of Pollution Stress." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 204 (1983).
263. Loetschert, W., "The Heavy Metal Content of Some Irish Plants." *J. Life Sci.*, **3,** 261 (1982); *C.A. Selects—Environ. Pollut.*, **20,** 97:107096r (1982).

264. Chetty, P. S., *et al.*, "Diurnal Rhythmicity in Total Protein and Copper Contents of the Blood of the Freshwater Field Crab, *Oziotelphusa senex senex* (Fabricius)." *Curr. Sci.* (Ind.), **52,** 615 (1983).
265. Allen, H. E., *et al.*, "An Algal Assay Method for Determination of Copper Complexation Capacities of Natural Waters." *Bull. Environ. Contam. Toxicol.*, **30,** 448 (1983).
266. Pearlmutter, N. L., and Buchheim, M. A., "Copper Susceptibility of Three Growth Stages of the Green Alga *Haematococcus.*" PB83–256768, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
267. Demayo, A., *et al.*, "Effects of Copper on Humans, Laboratory and Farm Animals, Terrestrial Plants, and Aquatic Life." *CRC Crit. Rev. Environ. Control,* **12,** 183 (1982).
268. Frevert, T., *et al.*, "Why Do River Jordan Algae Not Grow in Lake Kinneret?" In "Trace Substances in Environmental Health—XVI." D. D. Hemphill (Ed.), Univ. Missouri, Columbia, Mo., 174 (1982).
269. Svobodova, Z., "Changes in Some Haematological Parameters of the Carp After Intoxication With $CuSO_4 \cdot 5\ H_2O$." *Bull. Vyzk. Ustav Ryb. Hydrobiol.* (Czech.), **18,** 26 (1982); *Aquat. Sci. Fish. Abstr.*, **12,** 15569–1Q12 (1982).
270. Stephenson, R. R., "Effects of Water Hardness, Water Temperature, and Size of the Test Organisms on the Susceptibility of the Freshwater Shrimp, *Gammarus pulex* (L.), to Toxicants." *Bull. Environ. Contam. Toxicol.*, **31,** 459 (1983).
271. Stout, J., and Kilham, S. S., "Effects of p-Cresol on Photosynthetic and Respiration Rates of a Filamentous Green Alga (*Spirogyra*)." *Bull. Environ. Contam. Toxicol.*, **30,** 1 (1983).
272. Geiger, J. G., and Buikema, A. L., Jr., "Hydrocarbons Depress Growth and Reproduction of *Daphnia pulex* (Cladocera)." *Can. J. Fish. Aquat. Sci.*, **39,** 830 (1982).
273. Tryland, O., and Grande, M., "Removal of Cyanide From Scrubber Effluents and Its Effect on Toxicity to Fish." *Vatten* (Swed.), **39,** 168 (1983).
274. Leduc, G., *et al.*, "The Effects of Cyanides on Aquatic Organisms With Emphasis Upon Freshwater Fishes." NRCC No. 19246, Natl. Res. Council. Can., Ottawa, Canada (1982).
275. Tscheu-Schlueter, M., "Toxicity of Simple and Complex Cyanides to Aquatic Organisms." *Acta Hydrochim. Hydrobiol.*, **11,** 169 (1983); *C.A. Selects—Environ. Pollut.*, **16,** 99:34034y (1983).
276. Kovacs, T. G., and Leduc, G., "Acute Toxicity of Cyanide to Rainbow Trout (*Salmo gairdneri*) Acclimated at Different Temperatures." *Can. J. Fish. Aquat. Sci.*, **39,** 1426 (1982).
277. Keck, G., *et al.*, "Application of Acute Toxicity Tests to Toxicological Diagnosis of Fish Mortalities." *Colloq.—Inst. Natl. Sante Rech. Med.* (Fr.), **106,** 541 (1982); *C.A. Selects—Environ. Pollut.*, **7,** 98:102291m (1983).
278. Kovacs, T. G., and Leduc, G., "Sublethal Toxicity of Cyanide to Rainbow Trout (*Salmo gairdneri*) at Different Temperatures." *Can. J. Fish. Aquat. Sci.*, **39,** 1389 (1982).
279. Eisele, T. A., *et al.*, "Time- and Dose-Dependent Effects on Dietary Cyclopropenoid Fatty Acids on the Hepatic Microsomal Mixed Function Oxidase System of Rainbow Trout." *Aquat. Toxicol.*, **4,** 139 (1983).
280. Merwani, D., "Toxic Effect of Fernoxone (Weedicide) on Survival Percentage and Gulf Rate of *Punctius ticto* (Ham.)." *J. Sci. Res.*, **4,** 23 (1982).
281. Presing, M., and Vero, M., "A New Method for Determining the Heart Beat Rate of *Daphnia magna.*" *Water Res.*, (G. B.), **17,** 1245 (1983).
282. Jana, B. B., and De, U. K., "Stimulatory Effect of Herbicide 2,4-D on the Heteroptrophic Microbial Community in the Water of Three Fish Ponds." *Acta Microbiol. Acad. Sci. Hung.*, **29,** 77 (1982).
283. Lockhart, W. L., *et al.*, "Prediction of Biological Availability of Organic Chemical Pollutants to Aquatic Animals and Plants." In "Aquatic Toxicology and Hazard Assessment: Fifth Conference." ASTM STP 766, J. G. Pearson, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 259 (1982).
284. Carpenter, L. A., and Eaton, D. L., "The Disposition of 2,4-Dichlorophenoxyacetic Acid in Rainbow Trout." *Arch. Environ. Contam. Toxicol.*, **12,** 169 (1983).
285. Skaftason, J. F., and Johannesson, T., "Organochlorine Compounds in Icelandic Lake Trout and Salmon Fry: Local and Global Sources of Contamination." *Acta Pharmacol. Toxicol.*, **51,** 397 (1982).
286. Ilan, Z., and Yaron, Z., "Interference of o,p'DDD With Interrenal Function and Cortisol Metabolism in *Sarotherodon aureus* (Steindachner)." *J. Fish Biol.*, **22,** 657 (1983).
287. Agarwal, H. C., *et al.*, "Accumulation and Metabolism of DDT and Its Metabolites by *Tetrahymena.*" *Water, Air, Soil Pollut.*, **18,** 441 (1982).
288. Zasadowski, A., *et al.*, "Studies on Chlorinated Hydrocarbons Residues in the Brain and Muscle Fat of Some Fish Caught in Nets in Northeast Poland Waters." *Bromatol. Chem. Toksykol.* (Pol.), **15,** 145 (1982); *Aquat. Sci. Fish. Abstr.*, **13,** 2200–1Q13 (1983).
289. Perry, A. S., *et al.*, "Pesticide Residues in Fish and Aquatic Invertebrates." *Arch. Toxicol., Suppl.*, **6,** 199 (1983).
290. Baudin, J.-P., "Bioaccumulation and Elimination of ^{65}Zn by *Gammarus aequicauda* Martimov." *Mar. Environ. Res.*, **7,** 227 (1982); *Aquat. Sci. Fish. Abstr.*, **13,** 5524–1Q13 (1983).
291. Selivanova, V. A., *et al.*, "Effect of Pollutants on Protective Functions in Adult Silver Carp." *Rybn. Khoz. (Moscow),* **4,** 33 (1983); *C.A. Selects—Environ. Pollut.*, **14,** 99:1492t (1983).
292. Pandian, T. J., and Bhaskaran, R., "Uptake, Accumulation and Elimination of ^{14}DDT in the Fish *Channa striatus.*" *Indian J. Exp. Biol.*, **21,** 88 (1983).
293. Ramalingam, K., and Ramalingam, K., "Effects of Sublethal Levels of DDT, Malathion and Mercury on Tissue Proteins of *Sarotherodon mossambicus* (Peters)." *Proc. Indian Acad. Sci. (Ser.) Anim. Sci.*, **91,** 501 (1982); *C.A. Selects—Environ. Pollut.*, **18,** 99:65544u (1983).
294. Rohrer, T. K., *et al.*, "Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes—1980." *J. Great Lakes Res.*, **8,** 623 (1982).
295. Malyarevskaya, A. Y., "Regulation of Fish Metabolism in Toxicity." In "Reakts. Gidrobiontov Zagryaz." N. S. Stroganov (Ed.), 53, Izd. Nauka, Moscow, USSR (1983); *C.A. Selects—Environ. Pollut.*, **22,** 99:135132j (1983).
296. Shaffi, S. A., "DDT Toxicity: Gluconeogenic Enzymes and Non-Specific Phosphomonoesterases in Three Teleosts." *Toxicol. Lett.*, **13,** 11 (1982).
297. De la Cruz, A. A., and Yarbrough, J. D., "The Role of Aquatic Weeds in Maintaining Surface Water Quality." PB83–150094, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
298. Lockhart, W. L., *et al.*, "Uptake and Toxicity of Organic Compounds: Studies With an Aquatic Macrophyte (*Lemna minor*)." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 460 (1983).
299. Yu, D., and Yang, G., "Mercury, BHC and DDT Contents in the Freshwater Animals of P County." *Hangzhou Daxue Xeubao, Ziran Kexueban* (China), **9,** 482 (1982); *C.A. Selects—Environ. Pollut.*, **7,** 98:113356n (1983).
300. Fawade, M. M., *et al.*, "DDT Toxicity and Mixed Function Oxidases in the Freshwater Prawn, *Macrobrachium kistensis.*" *J. Environ. Biol.*, **4,** 81 (1983).
301. Palawski, D., *et al.*, "Survival and Condition of Rainbow Trout (*Salmo gairdneri*) After Acute Exposures to Methyl Parathion, Triphenyl Phosphate, and DEF." *Bull. Environ. Contam. Toxicol.*, **30,** 614 (1983).
302. Zanella, E., "Effect of pH on Acute Toxicity of Dehydroabietic Acid and Chlorinated Dehydroabietic Acid to Fish and *Daphnia.*" *Bull. Environ. Contam. Toxicol.*, **30,** 133 (1983).
303. Everts, J. W., *et al.*, "Side-Effects of Experimental Pyrethroid Applications for the Control of Tsetseflies in a Riverine Forest Habitat (Africa)." *Arch. Environ. Contam. Toxicol.*, **12,** 91 (1983).
304. Nishiuchi, Y., "Toxicity of Formulated Pesticides to Some Fresh-

water Organisms. LXXXV. Toxicity of Detergents to Carp and Water Flea." *Suisan Zoshoku* (Jpn.), **30,** 226 (1983); *C.A. Selects—Environ. Pollut.*, **23,** 99:153485f (1983).

305. Azov, Y., *et al.*, "Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond." *Appl. Environ. Microbiol.*, **43,** 491 (1982).
306. Gottschaldt, N., "Preparation and Evaluation of Water-Toxicological Study Results Illustrated by Surfactants." *Acta Hydrochim. Hydrobiol.*, **10,** 583 (1982); *C.A. Selects—Environ. Pollut.*, **9,** 98:138602c (1983).
307. Tanaka, A., *et al.*, "Studies on Simple Analytical Methods of Trace Pesticides in Water and Acute Toxicity to Fish. I. Simple Test Methods for Organophosphate Pesticides and Fish Swimming Test for Pesticide Toxicity. II." *Yosui to Haisui* (Jpn.), **24,** 907 (1982); *C.A. Selects—Environ. Pollut.*, **12,** 98:192988w (1983).
308. Sastry, K. V., and Malik, P. V., "Histopathological and Enzymological Alterations in the Digestive System of a Freshwater Teleost Fish, *Heteropneustes fossilis,* Exposed Acute and Chronically to Diazinon." *Ecotoxicol. Environ. Saf.*, **6,** 223 (1982).
309. Stalling, D. L., *et al.*, "Residues of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans in Laurentian Great Lakes Fish." In "Human and Environmental Risks of Chlorinated Dioxins and Related Compounds." R. E. Tucker, *et al.* (Eds.), Plenum Press, New York, N. Y. 221 (1983).
310. Calamari, D., *et al.*, "Toxicity of Selected Chlorobenzenes to Aquatic Organisms." *Chemosphere,* **12,** 253 (1983).
311. Galassi, S., *et al.*, "Uptake and Release of p-Dichlorobenzene in Early Life Stages of *Salmo gairdneri.*" *Ecotoxicol. Environ. Saf.*, **6,** 439 (1982).
312. Gupta, S., *et al.*, "Toxicity of Phenolic Compounds in Relation to the Size of a Freshwater Fish, *Notopterus notopterus* (Pallas)." *Ecotoxicol. Environ. Saf.*, **6,** 433 (1982).
313. Verma, S. R., *et al.*, "Pesticide-Induced Dysfunction in Carbohydrate Metabolism in Three Freshwater Fishes." *Environ. Res.*, **32,** 127 (1983).
314. Clark, D. R., Jr., *et al.*, "Gray Bats Killed by Dieldrin at Two Additional Missouri Caves: Aquatic Macroinvertebrates Found Dead." *Bull. Environ. Contam. Toxicol.*, **30,** 214 (1983).
315. Waltering, D. M., "Environmental Influence on the Response of Aquatic Laboratory Ecosystems to a Toxicant." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 153 (1983).
316. Liss, W. J., *et al.*, "Organization and Adaptation of Aquatic Laboratory Ecosystems Exposed to the Pesticide Dieldrin." PB82-219122, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
317. Mrowka, W., "Diethylpropion Decreases Food Intake in Fish." *Experientia* (Switz.), **39,** 289 (1983).
318. Laufer, H., "The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment." PB83-220582, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
319. Hansen, S. R., and Garton, R. R., "Ability of Standard Toxicity Tests to Predict the Effects of the Insecticide Diflubenzuron on Laboratory Stream Communities." *Can. J. Fish. Aquat. Sci.*, **39,** 1273 (1982).
320. Gilderhus, P. A., and Burress, R. M., "Selective Control of Common Carp: Ineffectiveness of 2-(Digeranylamino)-ethanol (GD-174) in Pond Trials." *North Am. J. Fish. Manage.*, **3,** 61 (1983).
321. Dubale, M. S., and Awasthi, M., "Biochemical Changes in the Liver and Kidney of a Catfish *Heteropneustes fossilis* Exposed to Dimethoate." *Comp. Physiol. Ecol.*, **7,** 111 (1982).
322. Hughes, J. S., and Vilkas, A. G., "Toxicity of N,N-Dimethylformamide Used as a Solvent in Toxicity Tests With the Green Alga, *Selenastrum capricornutum.*" *Bull. Environ. Contam. Toxicol.*, **31,** 98 (1983).
323. Barera, Y., and Adams, W. J., "Resolving Some Practical Questions About *Daphnia* Acute Toxicity Tests." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 509 (1983).
324. Verma, S. R., *et al.*, "Alterations in Certain Organic Components and Serum Electrolytes in *Notopterus notopterus* Chronically Exposed to Phenolic Compounds." *Acta Hydrochim. Hydrobiol.*, **10,** 31 (1982).
325. Gupta, S., *et al.*, "Effects of Phenolic Compounds on 5-Nucleotidase Activity in Some Tissues of *Notopterus notopterus* (Pallas): A Biochemical Study." *Toxicol. Lett.*, **17,** 167 (1983).
326. Gupta, S., *et al.*, "Effect of Phenolic Compounds on *In Vivo* Activity of Transaminases in Certain Tissues of the Fish, *Notopterus notopterus.*" *Environ. Res.*, **32,** 8 (1983).
327. Gupta, S., *et al.*, "Toxicity of Phenolic Compounds in Relation to the Size of a Freshwater Fish, *Notopterus notopterus* (Pallas)." *Ecotoxicol. Environ. Saf.*, **6,** 433 (1982).
328. Gupta, S., *et al.*, "Influence of Temperature on the Toxicity of Phenol and Its Chloro- and Nitro-Derivatives to the Fish *Notopterus notopterus* (Pallas)." *Acta Hydrochim. Hydrobiol.*, **11,** 187 (1983).
329. Birmingham, B. C., and Colman, B., "Potential Phytotoxicity of Diquat Accumulated by Aquatic Plants and Sediments." *Water, Air, Soil Pollut.*, **19,** 123 (1983).
330. Bates, S. S., *et al.*, "Variation in Zinc Adsorption and Transport During Growth of *Chlamydomonas variabilis* (Chlorophyceae) in Batch Culture With Daily Addition of Zinc." *Can. J. Fish. Aquat. Sci.*, **40,** 895 (1983).
331. Holcombe, G. W., *et al.*, "The Acute Toxicity of Kelthane, Dursban, Disulfoton, Pydrin, and Permethrin to Fathead Minnows *Pimephales promelas* and Rainbow Trout *Salmo gairdneri.*" *Environ. Pollut.*, **29A,** 167 (1982).
332. Werner, A. F., and Kimerle, R. A., "Uptake and Distribution of C_{12} Alkylbenzene in Bluegill (*Lepomis macrochirus*)." *Environ. Toxicol. Chem.*, **1,** 143 (1982).
333. Cravedi, J.-P., and Tulliez, J., "Chronic Ingestion of Saturated Hydrocarbons by Rainbow Trout: Influence of Dodecylcyclohexane and Pristane on Lipid Metabolism." *Arch. Environ. Contam. Toxicol.*, **11,** 719 (1982).
334. Kumamaru, A., "Studies on the Causes of Fish Death. I. Organophosphorus Pesticides." *Ibaraki-ken Naisuimen Suisan Shikenjo Chosa Kenkyu Hokoku* (Jpn.), **19,** 17 (1982); *C.A. Selects—Environ. Pollut.*, **15,** 99:17756t (1983).
335. Verma, S. R., *et al.*, "Evaluation of the Relative Resistance of Twelve Species of Fish in Toxicity Bioassays With Electroplating Waste." *Acta Hydrochim. Hydrobiol.*, **10,** 479 (1982).
336. Nebeker, A. V., "Evaluation of a *Daphnia magna* Renewal Life-Cycle Test Method With Silver and Endosulfan." *Water Res.* (G. B.), **16,** 739 (1982).
337. Gopal, K., *et al.*, "Haematological Changes in Fish Exposed to Endosulfan." *Ind. Health,* **20,** 157 (1982).
338. Manoharan, T., and Subbiah, G. N., "Toxic and Sublethal Effect of Endosulfan on *Barbus stigma* (Pisces: Cyprinidae)." *Proc. Indian Acad. Sci., Anim. Sci.*, **91,** 523 (1982); *Aquat. Sci. Fish. Abstr.*, **13,** 14537-1Q13 (1983).
339. Sastry, K. V., and Siddiqui, A. A., "Metabolic Changes in the Snake Head Fish *Channa punctatus* Chronically Exposed to Endosulfan." *Water, Air, Soil Pollut.*, **19,** 133 (1983).
340. Nebeker, A. V., *et al.*, "Relative Sensitivity of *Daphnia magna,* Rainbow Trout and Fathead Minnows to Endosulfan." *Environ. Toxicol. Chem.*, **2,** 69 (1983).
341. Takle, J. C. C., *et al.*, "Effect of the Aquatic Herbicide Endothal on the Critical Thermal Maximum of Red Shiner, *Notropis lutrensis.*" *Bull. Environ. Contam. Toxicol.*, **31,** 512 (1983).
342. Liguori, V. M., *et al.*, "Toxicity of the Herbicide Endothall to Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*)." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 530 (1983).
343. Hooftman, R. N., and de Raat, W. K., "Induction of Nuclear Anomalies (Micronuclei) in the Peripheral Blood Erythrocytes of

the Eastern Mudminnow *Umbra pygmaea* by Ethyl Methanesulphonate." *Mutat. Res.*, **104,** 147 (1982).

344. Plumb, J. A., *et al.*, "Experimental Anesthesia of Three Species of Freshwater Fish With Etomidate." *Prog. Fish Cult.*, **45,** 30 (1983).
345. Raizada, M. N., and Gupta, A., "Toxic Effects of RH-2161 (a Systemic Fungicide) on Total Erythrocyte Counts (RBC) and Haemoglobin Content (HB) of *Trichogaster fasciatus*." *Comp. Physiol. Ecol.*, **7,** 29 (1982).
346. Reddy, P. S., *et al.*, "*In Vivo* Sub-Acute Physiological Stress Induced by Sumithion on Carbohydrate Metabolism in Hepatopancreas of *Oziotelphusa senex senex* Fabricius." *Toxicol. Lett.*, **13,** 179 (1982).
347. Reddy, P. S., *et al.*, "Chronic Sumithion Toxicity: Effect on Carbohydrate Metabolism in Crab Muscle." *Toxicol. Lett.*, **15,** 113 (1983).
348. Bhagyalakshmi, A., *et al.*, "Muscle Nitrogen Metabolism of Freshwater Crab, *Oziotelphusa senex senex* Fabricius, During Acute and Chronic Sumithion Intoxication." *Toxicol. Lett.*, **17,** 89 (1983).
349. Bhagyalakshmi, A., *et al.*, "Changes in Hemolymph Glucose, Hepatopancreas Glycogen, Total Carbohydrates, Phosphorylase and Amino Transferases of Sumithion-Stressed Freshwater Rice-Field Crab (*Oziotelphusa senex senex*)." *Toxicol. Lett.*, **18,** 277 (1983).
350. Reddy, P. S., *et al.*, "Effect of Sumithion on Ovarian Growth of a Fresh Water Rice Field Crab (*Oziotelphusa senex senex* Fabricius)." *Toxicol. Lett.*, **18,** 273 (1983).
351. Reddy, P. S., *et al.*, "Effect of Sumithion on Molting of the Freshwater Rice-Field Crab (*Oziotelphusa senex senex* Fabricius)." *Toxicol. Lett.*, **14,** 243 (1982).
352. Hasegawa, J., *et al.*, "Impact of Temephos and Fenitrothion on Aquatic Invertebrates in a Stream of Mt. Tsukuba." *Jpn. J. Sanit. Zool.*, **33,** 363 (1982).
353. Weinberger, P., *et al.*, "Interactions Between Co-Solvents and Algae in the Residue Dynamics of Fenitrothion." *J. Environ. Sci. Health*, **18B,** 269 (1983).
354. Murty, A. S., *et al.*, "Toxicity of Fenitrothion to the Fish *Mystus cavasius* and *Labeo rohita*." *Environ. Pollut.*, **30A,** 225 (1983).
355. Srivastava, A. K., and Mishra, J., "Effects of Fenthion on the Blood and Tissue Chemistry of a Teleost Fish (*Heteropneustes fossilis*)." *J. Comp. Pathol.*, **93,** 27 (1983).
356. Spehar, R. L., *et al.*, "Effects of Kelthane and Pydrin on Early Life Stages of Fathead Minnows (*Pimephales promelas*) and Amphipods (*Hyalella azteca*)." In "Aquatic Toxicology and Hazard Assessment: Fifth Conference." ASTM STP 766, J. G. Pearson, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 234 (1982).
357. Coulon, D. P., "Toxicity of Ambush and Pydrin to Red Crawfish, *Procambarus clarkii* (Girard) and Channel Catfish, *Ictaluras punctatus* Rafinesque in Laboratory and Field Studies and the Accumulation and Dissipation of Associated Residues." *Diss. Abstr. Int. B*, **44,** 36 (1983).
358. Anderson, R. L., "Toxicity of Fenvalerate and Permethrin to Several Nontarget Aquatic Invertebrates." *Environ. Entomol.*, **11,** 1251 (1982).
359. Rashatwar, S. S., and Ilyas, R., "Effect of Chronic Herbicide Intoxication on *In Vivo* Activities of Certain Enzymes in the Liver of Freshwater Fish *Nemachelius denisonii* (Day)." *Toxicol. Lett.*, **16,** 249 (1983).
360. Chitra, T., *et al.*, "Ionic Variations in Tissues of *Channa punctatus* Bloch on Exposure to Sodium Fluoride." *Fluoride*, **16,** 60 (1983).
361. Zhang, R., and Zhang, S., "Toxicity of Fluorides to Fishes." *Huanjing Kexue* (China), **3,** 1 (1982); *C.A. Selects—Environ. Pollut.*, **24,** 97:176354k (1982).
362. Spencer, D. F., *et al.*, "Alterations in the Zooplankton Communities of a Fly Ash Treated Lake." *Hydrobiologia* (Den.), **107,** 123 (1983).
363. Carmichael, G. J., "Use of Formalin to Separate Tadpoles From Largemouth Bass Fingerlings After Harvesting." *Prog. Fish Cult.*, **45,** 105 (1983).
364. Gomes, P. B., and Dietrich, C. P., "Distribution of Heparin and Other Sulfated Glycosaminoglycans in Vertebrates." *Comp. Biochem. Physiol., B*, **73,** 857 (1982).
365. Paasivirta, J., *et al.*, "Potential Off-Flavour Compounds From Chloro-Bleaching of Pulp and Chlorodisinfection of Water." *Water Sci. Tech.*, **15,** 97 (1983).
366. Reddy, P. S., *et al.*, "*In Vivo* Acute Physiological Stress Induced by BHC on Hemolymph Biochemistry of *Oziotelphusa senex senex*, the Indian Rice Field Crab." *Toxicol. Lett.*, **18,** 35 (1983).
367. Gupta, B. H. A., and Singh, C. P., "Histopathological Changes in Different Tissues of *T. fasciatus* Under the Acute Impact of BHC." *Toxicol. Lett.*, **14,** 151 (1982).
368. Reddy, P. S., *et al.*, "Hyperglycemia in the Fresh Water Field Crab (*Oziotelphusa senex senex*) Produced by a Pesticide (BHC)." *Z. Naturforsch., C: Biosci.*, **37,** 545 (1982).
369. Sinhaseni, P., *et al.*, "Respiratory Effects of Hexachlorocyclopentadiene on Intact Rainbow Trout (*Salmo gairdneri*) and on Oxidative Phosphorylation of Isolated Trout Heart Mitochondria." *Toxicol. Appl. Pharmacol.*, **67,** 215 (1983).
370. Sinhaseni, P., "Biological Effects of Hexachlorocyclopentadiene in the Rainbow Trout, *Salmo gairdneri*." *Diss. Abstr. Int. B*, **43,** 375 (1982).
371. Kane, D. A., and Williamson, K. J., "Bacterial Toxicity and Metabolism of Hydrazine Fuels." *Arch. Environ. Contam. Toxicol.*, **12,** 447 (1983).
372. Henderson, V., *et al.*, "Effects of Hydrazine on Functional Morphology of Rainbow Trout Embryos and Larvae." *Trans. Am. Fish. Soc.*, **112,** 100 (1983).
373. Sharma, R. K., *et al.*, "Toxicity of Kiazin on Two Air-Breathing Fish." *Toxicol. Lett.*, **13,** 7 (1982).
374. Saxena, P. K., and Bhatia, R., "Effect of Vegetable Oil Factory Effluent on Ovarian Recrudescence in the Fresh Water Teleost, *Channa punctatus* (Bl.)." *Water, Air, Soil Pollut.*, **20,** 55 (1983).
375. Behera, B. K., and Misra, B. N., "Analysis of the Effect of Industrial Effluent on Pigments, Proteins, Nucleic Acids, and the 2,6-Dichlorophenol Indophenol Hill Reaction of Rice Seedlings." *Environ. Res.*, **31,** 381 (1983).
376. Amelung, M., "Effects of Dissolved Iron Compounds on Developing Eggs and Larvae on *Salmo gairdneri* (Richardson)." *Arch. Fischerewiss.* (Ger.), **32,** 77 (1982); *C.A. Selects—Environ. Pollut.*, **19,** 97:86457s (1982).
377. Sode, A., "Effect of Ferric Hydroxide on Algae and Oxygen Consumption by Sediment in a Danish Stream." *Arch. Hydrobiol., Suppl.*, **65,** 134 (1983).
378. Khangarot, B. S., "Acute Toxicity of Zinc to *Channa punctatus* (Bloch), as a Result of Temperature, pH and Solubility Variations." *Acta Hydrochim. Hydrobiol.*, **10,** 401 (1982).
379. Fisher, J. W., *et al.*, "Biological Monitoring of Bluegill Activity." *Water Resource. Bull.*, **19,** 211 (1983).
380. Henderson, V., "Scale Morphologic Response to Aromatic Hydrocarbons." *Bull. Environ. Contam. Toxicol.*, **31,** 315 (1983).
381. Latendressee, J. R., II, and Fisher, J. W., "Histopathologic Effects of JP-4 Aviation Fuel on Fathead Minnows (*Pimephales promelas*)." *Bull. Environ. Contam. Toxicol.*, **30,** 536 (1983).
382. Klein, S. A., and Jenkins, D., "The Toxicity of Jet Fuels to Fish. II. The Toxicity of JP-8 to Flagfish (*Jordanella floridae*) and Rainbow Trout (*Salmo gairdneri*) and Golden Shiners (*Notemigonus chysoleucas*)." *Water Res.* (G. B.), **17,** 1213 (1983).
383. Eaton, J. G., *et al.*, "Effects of Suspended Clay on Bioconcentration of Kelthane in Fathead Minnows." *Arch. Environ. Contam. Toxicol.*, **12,** 439 (1983).
384. Johnson, B. T., "Impact of Xenobiotic Chemicals in Microbial Ecosystems." Tech. Pap. 107, U. S. Fish Wildl. Serv., U. S. Dept. Interior, Columbia, Mo. (1982).
385. Swift, M. C., "Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities." PB83-220541, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).
386. Hall, L. W., Jr., and Burton, D. T., "Effects of Power Plant Coal Pile and Coal Waste Runoff and Leachate on Aquatic Biota: An

Overview With Research Recommendations." *CRC Crit. Rev. Toxicol.*, **10,** 287 (1982).

387. Atwater, J. W., *et al.*, "Experiments Using Daphnia to Measure Landfill Leachate Toxicity." *Water Res.* (G. B.), **17,** 1855 (1983).
388. Sippel, A. J., *et al.*, "Histopathological and Physiological Responses of Rainbow Trout (*Salmo gairdneri* Richardson) to Sublethal Levels of Lead." *Water Res.* (G. B.), **17,** 1115 (1983).
389. Kodama, M., *et al.*, "Hemolysis of Erythrocytes of Rainbow Trout *Salmo gairdneri* Exposed to Zinc Polluted Water." *Bull. Jpn. Soc. Sci. Fish.*, **48,** 593 (1982).
390. Newman, M. C., *et al.*, "Geochemical Factors Complicating the use of *Aufwuchs* as a Biomonitor for Lead Levels in Two New Jersey Reservoirs." *Water Res.* (G. B.), **17,** 625 (1983).
391. Ellgaard, E. G., and Rudner, T. W., "Lead Acetate: Toxicity Without Effects on the Locomotor Activity of the Bluegill Sunfish, *Lepomis macrochirus* Rafinesque." *J. Fish Biol.*, **21,** 411 (1982).
392. Newman, M. C., and McIntosh, A. W., "Lead Elimination and Size Effects on Accumulation by Two Freshwater Gastropods." *Arch. Environ. Contam. Toxicol.*, **12,** 25 (1983).
393. Marion, M., and Denizeau, F., "Rainbow Trout and Human Cells in Culture for the Evaluation of the Toxicity of Aquatic Pollutants: A Study With Lead." *Aquat. Toxicol.*, **3,** 47 (1983).
394. Hodson, P. V., *et al.*, "Suitability of a Biochemical Method for Assessing the Exposure of Feral Fish to Lead." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 389 (1983).
395. Gale, N. L., *et al.*, "Lead Concentrations in Edible Fish Filets Collected From Missouri's Old Lead Belt." In "Trace Substances in Environmental Health—XVI." D. D. Hemphill (Ed.), Univ. Missouri, Columbia, 12 (1982).
396. Demayo, A., *et al.*, "Toxic Effects of Lead and Lead Compounds on Human Health, Aquatic Life, Wildlife Plants, and Livestock." *CRC Crit. Rev. Environ. Control*, **12,** 257 (1982).
397. Drewett, N., and Abel, P. D., "Pathology of Lindane Poisoning and of Hypoxia in the Brown Trout, *Salmo trutta* L." *J. Fish Biol.*, **23,** 373 (1983).
398. Chaturvedi, L. D., and Saxena, V. P., "Quantitative Measures of Lindane and Malathion Residues in Some Tissues of *Channa punctatus*." *Toxicol. Lett.*, **18,** 156 (1983).
399. Bakthavathasalam, R., and Reddy, Y. S., "Intoxication Effects of Lindane (γ-BHC) on the Activities of Aspartate and Alanine Aminotransferases of *Anabas testudineus* (Bloch)." *Pestic. Biochem. Physiol.*, **18,** 226 (1982).
400. Rodgers, J. H., Jr., *et al.*, "Bioconcentration of Lindane and Naphthalene in Bluegills (*Lepomis macrochirus*)." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 300 (1983).
401. Marcelle, C., and Thome, J. P., "Acute Toxicity and Bioaccumulation of Lindane in Gudgeon, *Gobio gobio* (L.)." *Bull. Environ. Contam. Toxicol.*, **13,** 453 (1983).
402. Hashimoto, Y., and Nishiuchi, Y., "Effects of Herbicides on Aquatic Animals." In "Pesticide Chemistry: Human Welfare and the Environment." J. Miyamoto and P. C. Kearney (Eds.), Pergamon Press, Oxford, U. K., 355 (1983).
403. Danil'chenko, O. P., *et al.*, "Ecological Harmfulness of Chemical Compounds." In "Teor. Probl. Vodn. Toksikol." N. S. Stroganov (Ed.), 167, Izd. Nauka, Moscow, USSR (1983); *C.A. Selects—Environ. Pollut.*, **21,** 99:117472r (1983).
404. Taub, F. B., *et al.*, "Demonstration of the Ecological Effects of Streptomycin and Malathion on Synthetic Aquatic Microcosms." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 5 (1983).
405. Tandon, R. S., and Dubey, A., "Toxic Effects of Two Organophosphorus Pesticides on Fructose-1,6-Diphosphate Aldolase Activity of Liver, Brain and Gills of the Freshwater Fish *Clarias batrachus*." *Environ. Poll.*, **31A,** 1 (1983).
406. Nagabhushanam, R., *et al.*, "Toxicity of Three Organophosphate Compounds and Their Effect on the Gonad of Freshwater Prawn, *Macrobrachium lamerrii*." *Indian J. Comp. Anim. Physiol.*, **1,** 71 (1983).
407. Mishra, J., and Srivastava, A. K., "Malathion Induced Hematological and Biochemical Changes in the Indian Catfish *Heteropneustes fossilis*." *Environ. Res.*, **30,** 393 (1983).
408. Sharma, R. K., *et al.*, "Observations on the Effect of Malathion on the Mortality of Fish, *Clarias batrachus* (Linn.)." *Comp. Physiol. Ecol.*, **8,** 155 (1983).
409. Kyle, J. H., and Ghani, N., "Mercury Concentrations in Ten Species of Fish From Lake Murray, Western Province." *Sci. New Guinea*, **9,** 48 (1982); *Sports Fish. Abstr.*, **28,** 83–001168 (1983).
410. Cooper, J. J., "Total Mercury in Fishes and Selected Biota in Lahontan Reservoir, Nevada: 1981." *Bull. Environ. Contam. Toxicol.*, **31,** 9 (1983).
411. Koops, H., *et al.*, "On Culture of Mercury Polluted Eels From the Elbe River." *Inf. Fischwirtsch.*, **29,** 71 (1982); *Aquat. Sci. Fish. Abstr.*, **13,** 4048–1Q13 (1983).
412. Kawamata, S., *et al.*, "High Level Mercury Accumulation in Lake Ontake Fish." *Nippon Koshu Eisei Zasshi* (Jap.), **29,** 551 (1982); *C.A. Selects—Environ. Pollut.*, **7,** 98:113359r (1983).
413. Milbrink, G., "Characteristic Deformities in Tubificid Oligochaetes Inhabiting Polluted Bays of Lake Vanern, Southern Sweden." *Hydrobiolia* (Den.), **106,** 169 (1983).
414. Lodenius, M., *et al.*, "Accumulation of Mercury in Fish and Man From Reservoirs in Northern Finland." *Water, Air, Soil Pollut.*, **19,** 237 (1983).
415. Baluja, G., *et al.*, "Mercury Distribution in an Ecosystem of the "Parque Nacional de Donana," Spain." *Bull. Environ. Contam. Toxicol.*, **30,** 544 (1983).
416. Rodgers, D. W., and Qadri, S. U., "Growth and Mercury Accumulation in Yearling Yellow Perch, *Perca flavescens*, in the Ottawa River, Ontario." *Environ. Biol. Fish.*, **7,** 377 (1982).
417. Kristensen, P., "Time-Dependent Variation of Mercury in a Stream Sediment and the Effect Upon Mercury Content in *Gammarus pulex* (L.)." *Water Res.* (G. B.), **16,** 759 (1982).
418. Shon, D. H., *et al.*, "A Study of the Total Mercury Content in Freshwater Fishes." *Hanguk Sikp'um Kwahakhoe Chi* (Korea), **14,** 168 (1982); *C.A. Selects—Environ. Pollut.*, **18,** 97:70992b (1982).
419. Favarger, P. Y., "Mercury Content of Fish From Swiss Lakes, 1973–1979." *Chimia*, **36,** 365 (1982); *C.A. Selects—Environ. Pollut.*, **1,** 98:1357g (1983).
420. Storozhuk, N. G., and Smirnov, B. P., "Effect of Mercury on the Respiration Rate of Larval Pink Salmon, *Oncohynchus gorbuscha*." *J. Ichthyol. (Engl. Trans.)*, **22,** 168 (1982).
421. Ram, R. N., and Sathyanesan, A. G., "Effect of Mercuric Chloride on the Reproductive Cycle of the Teleostean Fish *Channa punctatus*." *Bull. Environ. Contam. Toxicol.*, **30,** 24 (1983).
422. Trevors, J. T., "A Comparison of Methods for Assessing Toxicant Effects on Algal Growth." *Biotechnol. Lett.*, **4,** 243 (1982).
423. Naidu, K. A., *et al.*, "Histological Observations in Gills of the Teleost *Sarotherodon mossambicus* With Reference to Mercury Toxicity." *Ecotoxicol. Environ. Saf.*, **7,** 455 (1983).
424. Itazawa, Y., and Kanda, T., "Group Effects on Physiological and Ecological Phenomena in Fish. V. Effects of Fish Density and Fish Number on Survival Time of Goldfish in Sublimate Solution Containing Mercuric Chloride." *Nippon Suisan Gakkaishi* (Jpn.), **49,** 733 (1983); *C.A. Selects—Environ. Pollut.*, **15,** 99:17672n (1983).
425. Verma, S. R., *et al.*, "*In Vivo* Effect of Mercuric Chloride on Tissue ATPases of *Notopterus notopterus*." *Toxicol. Lett.*, **16,** 305 (1983).
426. Trevors, J. T., *et al.*, "The Use of Electron Transport System Activity for Assessing Toxicant Effects on Algae." *Water, Air, Soil Pollut.*, **19,** 361 (1983).

427. Verma, S. R., and Tonk, I. P., "Effect of Sublethal Concentrations of Mercury on the Composition of Liver, Muscles and Ovary of *Notopterus notopterus*." *Water, Air, Soil Pollut.*, **20,** 287 (1983).
428. Sastry, K. V., and Rao, D. R., "Mercuric Chloride Induced Alterations in the Intestinal Transport of Glucose and Fructose in the Fresh Water Murrel *Channa punctatus*." *Water, Air, Soil Pollut.*, **19,** 143 (1983).
429. Klaverkamp, J. F., *et al.*, "Joint Toxicity of Mercury and Selenium in Salmonid Eggs." *Arch. Environ. Contam. Toxicol.*, **12,** 415 (1983).
430. Rana, S. V. S., and Shrma, R., "Mercurial Toxicity in the Liver of a Freshwater Teleost *Channa punctatus*." *Toxicol. Lett.*, **11,** 7 (1982).
431. Roderer, G., "Differential Toxic Effects of Mercuric Chloride and Methylmercuric Chloride on the Freshwater Alga *Poterioochromonas malhamensis*." *Aquat. Toxicol.*, **3,** 23 (1983).
432. Feron, J. P., and Reust, H., "Effects of the Holding Time and the Length of the Experiment on the LC50 Value in Rainbow Trout (*Salmo gairdneri*) and Zebra Danio (*Brachydanio rerio*)." *Tenside Deterg.* (Ger.), **20,** 65 (1983); *C.A. Selects—Environ. Pollut.*, **13,** 98:210916c (1983).
433. Ribeyre, F., and Boudou, A., "Study of the Dynamics of the Accumulation of Two Mercury Compounds—$HgCl_2$ and CH_3HgCl—by *Chlorella vulgaris:* Effect of Temperature and pH Factor of the Environment." *Int. J. Environ. Stud.*, **20,** 35 (1982).
434. Rana, S. V. S., and Sharma, R., "Co-Enzyme Effects of Inorganic Mercury in the Liver of a Freshwater Fish *Channa punctatus*." *JAT, J. Appl. Toxicol.*, **2,** 275 (1982).
435. Sastry, K. V., and Rao, D. R., "Effect of Mercuric Chloride on the Intestinal Absorption of an Amino Acid, Glycine, in the Freshwater Murrel, *Channa punctatus*." *Toxicol. Lett.*, **11,** 11 (1982).
436. Sarasquete, M. C., *et al.*, "Effect of Inorganic Mercury ($HgCl_2$) on the Blood and Kidney of Toadfish, *Halobatrachus didactylus* (Schneider, 1801)." *Invest. Pesq.* (Sp.), **46,** 323 (1982); *C.A. Selects—Environ. Pollut.*, **5,** 98:66634q (1983).
437. Chang, P. S. S., *et al.*, "The Effects of Low pH, Selenium and Calcium on the Bioaccumulation of ^{203}Hg by Seven Tissues of the Crayfish, *Orconectes virilis*." *Can. Tech. Rep. Fish. Aquat. Sci.*, **1151,** 45 (1983).
438. Herrick, C. J., *et al.*, "A Model of Mercury Contamination in a Woodland Stream." *Ecol. Modeling*, **15,** 1 (1982).
439. Das, A. K., and Misra, B. N., "Toxicity of MEMC (2-Methoxy ethyl mercuric chloride) on Organomercurial Fungicide to Fish, *Cyprinus carpio* (L.)." *J. Environ. Biol.*, **3,** 19 (1982).
440. Cenini, P., and Turner, R. J., "*In Vitro* Effects of Zinc on Lymphoid Cells of the Carp, *Cyprinus carpio* L." *J. Fish Biol.*, **23,** 579 (1983).
441. Hawryshyn, C. W., *et al.*, "Methyl Mercury Induced Visual Deficits in Rainbow Trout." *Can. J. Zool.*, **60,** 3127 (1982).
442. Klaverkamp, J. F., *et al.*, "Selenite Toxicity and Mercury-Selenium Interactions in Juvenile Fish." *Arch. Environ. Contam. Toxicol.*, **12,** 405 (1983).
443. Stary, J., *et al.*, "The Cumulation of Methylmercury and Phenylmercury Species on Alga." *J. Indian Chem. Soc.*, **59,** 1329 (1982).
444. Rodgers, D. W., and Beamish, F. W. H., "Water Quality Modifies Uptake of Waterborne Methylmercury by Rainbow Trout, *Salmo gairdneri*." *Can. J. Fish. Aquat. Sci.*, **40,** 824 (1983).
445. Xiu, R., *et al.*, "Study on the Accumulation of Methylmercury in Aquatic Food Chains." *Zhonghua Yufangyixue Zazhi* (China), **16,** 218 (1982); *C.A. Selects—Environ. Pollut.*, **4,** 98:48189u (1983).
446. Dutta, H. M., *et al.*, "Methyl Mercury Induced Changes in the Serum Proteins of Bluegills—*Lepomis machrochirus* (Teleostei)." *Ohio J. Sci.*, **83,** 119 (1983).
447. Tantawy, M. M., and Grimme, L. H., "The Bleaching Induced by the Phenylpyridazinone Herbicide Metfluazon in *Chlorella* is a Metabolic and Reversible Process." *Pestic. Biochem. Physiol.*, **18,** 304 (1982).
448. Kirino, O., *et al.*, "Quantitative Structure-Activity Relationships of the Herbicidal N-(1-Methyl-1-phenylethyl)acylamides." *J. Pestic. Sci.*, **8,** 301 (1983).
449. Tan, B., and Melius, P., "Effects of 3-Methylcholanthrene on the Hepatic Microsomal Enzymes in a Teleost, *Tilapia aurea*." *Bull. Environ. Contam. Toxicol.*, **31,** 292 (1983).
450. Rao, K. S. P., and Rao, K. V. R., "Regulation of Phosphorylases and Aldolases in Tissues of the Teleost (*Tilapia mossambica*) Under Methyl Parathion Impact." *Bull. Environ. Contam. Toxicol.*, **31,** 474 (1983).
451. Palawski, D., *et al.*, "Survival and Condition of Rainbow trout (*Salmo gairdneri*) After Acute Exposures to Methyl Parathion, Triphenyl Phosphate, and DEF." *Bull. Environ. Contam. Toxicol.*, **30,** 614 (1983).
452. Rao, K. S. P., and Rao, K. V. R., "Toxicity of Methyl Parathion to the Fresh Water Teleost, *Tilapia mossambica* (Peters)." *Comp. Physiol. Ecol.*, **7,** 271 (1982).
453. Mahendru, V. K., and Agarwal, R. A., "Phorate and Mexacarbate Induced Changes in Enzymes of the Snail, *Lymnaea acuminata*." *Arch. Environ. Contam. Toxicol.*, **12,** 77 (1983).
454. Gore, J. A., "The Distribution of Desmognathine Larvae (Amphibia: Plethodontidae) in Coal Surface Mine Impacted Streams of the Cumberland Plateau, USA." *J. Freshwater Ecol.*, **2,** 13 (1983).
455. Lampkin, A. J., III, and Sommerfeld, M. R., "Algal Distribution in a Small Intermittent Stream Receiving Acid Mine-Drainage." *J. Phycol.*, **18,** 196 (1982).
456. Chadwick, J. W., and Canton, S. P., "Coal Mine Drainage Effects on a Lotic Ecosystem in Northwest Colorado, U. S. A." *Hydrobiologia* (Den.), **107,** 25 (1983).
457. Insalaco, S. E., *et al.*, "The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon." *J. Great Lakes Res.*, **8,** 660 (1982).
458. Jessiman, B. J., and Qadri, S. U., "Bioaccumulation Kinetics of the Organochlorine Pesticide Mirex in Amphipods." *Ecotoxicol. Environ. Saf.*, **7,** 295 (1983).
459. Desjardins, C., *et al.*, "Contamination by Mirex of the Eel (*Anguilla rostrata*) of the St. Lawrence River Basin." Can. Ind. Rep. Fish. Aquat. Sci. No. 141, Dep. Fish. Oceans, Quebec, Canada (1983); *Aquat. Sci. Fish. Abstr.*, **13,** 14619–1Q13 (1983).
460. Tikhonova, K. S., and Shekhanova, I. A., "Effect of Pesticides on Russian Sturgeon, *Acipenser guildenstaedti* (Acipenseridae), in the Embryonic-Larval Period." *J. Ichthyol. (Engl. Trans.)*, **22,** 172 (1982).
461. Colborn, T., "Measurement of Low Levels of Molybdenum in the Environment by Using Aquatic Insects." *Bull. Environ. Contam. Toxicol.*, **29,** 422 (1982).
462. Mulla, M. S., and Darwazeh, H. A., "Efficacy of Petroleum Larvicidal Oils and Their Impact on Some Aquatic Nontarget Organisms." *Proc. Pap. Annu. Conf. Calif. Mosq. Vector Control Assoc.*, **49,** 84 (1982); *C. A. Selects—Environ. Pollut.*, **19,** 97:87019n (1982).
463. Yamagishi, T., *et al.*, "Synthetic Musk Residues in Biota and Water From Tama River and Tokyo Bay (Japan)." *Arch. Environ. Contam. Toxicol.*, **12,** 83 (1983).
464. Engelhardt, F. R., *et al.*, "Effects of Petroleum Hydrocarbons on Trophic Factors of *Daphnia pulex*." In "Land and Water Issues Related to Energy Development." P. J. Rand (Ed.), Ann Arbor Sci., Ann Arbor, Mich., 297 (1982).
465. Moles, A., and Rice, S. D., "Effects of Crude Oil and Naphthalene on Growth, Caloric Content, and Fat Content of Pink Salmon Juveniles in Seawater." *Trans. Am. Fish. Soc.*, **112,** 205 (1983).
466. Dange, A. D., and Masurekar, V. B., "Naphthalene-Induced Changes in Carbohydrate Metabolism in *Sarotherodon mossambicus* Peters (Pisces: Cichlidae)." *Hydrobiologia* (Den.), **94,** 163 (1982).
467. Correa, M., and Coler, R., "Enhanced Oxygen Uptake Rates in Dragonfly Nymphs (*Somatochlora cingulata*) as an Indication of

Stress From Naphthalene." *Bull. Environ. Contam. Toxicol.*, **30,** 269 (1983).
468. Edmisten, G. E., and Bantle, J. A., "Use of *Xenopus laevis* Larvae in 96-Hour, Flow-Through Toxicity Tests With Naphthalene." *Bull. Environ. Contam. Toxicol.*, **29,** 392 (1982).
469. Woodward, D. F., *et al.*, "Accumulation, Sublethal Effects, and Safe Concentration of a Refined Oil as Evaluated With Cutthroat Trout." *Arch. Environ. Contam. Toxicol.*, **12,** 455 (1983).
470. Simakhov, Y. G., "The Influence of Benzene Compounds on the Mitotic Activity of the Epithelium of the Eye Lens of Rainbow Trout, *Salmo gairdneri*." *J. Ichthyol. (Engl. Trans.)*, **22,** 135 (1982).
471. Babich, H., and Stotzky, G., "Temperature, pH, Salinity, Hardness, and Particulates Mediate Nickel Toxicity to Eubacteria, and Actinomycete, and Yeasts in Lake, Simulated Estuarine, and Sea Waters." *Aquat. Toxicol.*, **3,** 195 (1983).
472. Spencer, D. F., and Nichols, L. H., "Free Nickel Ion Inhibits Growth of Two Species of Green Algae." *Environ. Pollut.*, **31A,** 97 (1983).
473. Grizzle, J. M., "Effects on Channel Catfish of High Nitrite Concentrations That Occur in Fish Ponds." PB83-246470, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
474. Tucker, C. S., and Schwedler, T. E., "Acclimation of Channel Catfish (*Ictalurus punctatus*) to Nitrite." *Bull. Environ. Contam. Toxicol.*, **30,** 516 (1983).
475. Eddy, F. B., *et al.*, "Uptake and Loss of Nitrite From the Blood of Rainbow Trout, *Salmo gairdneri* Richardson, and Atlantic Salmon, *Salmo salar* L. in Fresh Water and in Dilute Sea Water." *J. Fish Biol.*, **23,** 105 (1983).
476. Tucker, C. S., and Schwedler, T. E., "Variability of Percent Methemoglobin in Pond Populations in Nitrite-Exposed Channel Catfish." *Prog. Fish. Cult.*, **45,** 108 (1983).
477. Shukla, G. S., *et al.*, "Cadmium and Zinc Toxicity to an Aquatic Insect, *Ranatra elongata* (Fabr.)." *Toxicol. Lett.*, **15,** 39 (1983).
478. Huey, D. W., "Lethal and Sublethal Effects of Hemoxidants, Particularly Nitrite, on Selected Aquatic Animals." *Diss. Abstr. Int. B*, **43,** 650 (1983).
479. Krous, S. R., *et al.*, "Effect of Acclimation Time on Nitrite Movement Across the Gill Epithelia of Rainbow Trout: The Role of 'Chloride Cells'." *Prog. Fish Cult.*, **44,** 126 (1982).
480. Garrett, W. R., Jr., "Toxic Effects of Nitrite on Channel Catfish." PB83-246934, NTIS, U. S. Dept. Commerce, Springfield, Va. (1983).
481. Margiocco, C., *et al.*, "Nitrite Bioaccumulation in *Salmo gairdneri* Rich. and Hematological Consequences." *Aquat. Toxicol.*, **3,** 261 (1983).
482. Folmar, L. C., and Hodgins, H. O., "Effects of Aroclor 1254 and No. 2 Fuel Oil, Singly and in Combination, on Predator-Prey Interactions in Coho Salmon (*Oncorhynchus kisutch*)." *Bull. Environ. Contam. Toxicol.*, **29,** 24 (1982).
483. Wong, C. K., *et al.*, "Feeding Behavior of *Daphnia pulex* in Crude Oil Dispersions." *Bull. Environ. Contam. Toxicol.*, **31,** 152 (1983).
484. Ullrich, S. O., Jr., and Millemann, R. E., "Survival, Respiration, and Food Assimilation of *Daphnia magna* Exposed to Petroleum- and Coal-Derived Oils at Three Temperatures." *Can. J. Fish. Aquat. Sci.*, **40,** 17 (1983).
485. Hedtke, S. F., and Puglisi, F. A., "Short-Term Toxicity of Five Oils to Four Freshwater Species." *Arch. Environ. Contam. Toxicol.*, **11,** 425 (1982).
486. Bobra, A. M., *et al.*, "Acute Toxicity of Fresh and Weathered Crude Oils to *Daphnia magna*." *Chemosphere*, **12,** 1137 (1983).
487. Giddings, J. M., "Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms." *Arch. Environ. Contam. Toxicol.*, **11,** 735 (1982).
488. Werner, M. D., *et al.*, "An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems." PB83-219774, NTIS, U. S. Dept. Commerce, Springfield, VA (1983).
489. Naqvi, S. M., and Leung, T.-S., "Trifluralin and Oryzalin Herbicides Toxicities to Juvenile Crawfish (*Procambarus clarkii*) and Mosquitofish (*Gambusia affinis*)." *Bull. Environ. Contam. Toxicol.*, **31,** 304 (1983).
490. Black, J. J., "Field and Laboratory Studies of Environmental Carcinogenesis in Niagara River Fish." *J. Great Lakes Res.*, **9,** 326 (1983).
491. Lederman, T. C., and Rhee, G.-Y., "Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae." *Can. J. Fish. Aquat. Sci.*, **39,** 380 (1982).
492. Powers, C. D., *et al.*, "Field and Laboratory Studies of the Toxicity to Phytoplankton of Polychlorinated Biphenyls (PCBs) Desorbed From Fine Clays and Natural Suspended Particulates." *J. Great Lakes Res.*, **8,** 350 (1982).
493. Jensen, A. L., *et al.*, "PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York." *Can. J. Fish. Aquat. Sci.*, **39,** 700 (1982).
494. Anderson, M. L., *et al.*, "Residues of PCB in a *Cladophora* Community Along the Lake Huron Shoreline." *J. Great Lakes Res.*, **8,** 196 (1982).
495. Baba, H., *et al.*, "PCB Concentration in Fish, Human Milk, and Blood." *Nagasaki-ken Eisei Kogai Kenkyusho Ho* (Jpn.), **21,** 142 (1982); *C. A. Selects—Environ. Pollut.*, **23,** 97:161211n (1983).
496. Sayler, G. S., *et al.*, "Effects of Polychlorinated Biphenyls and Environmental Biotransformation Products on Aquatic Nitrification." *Appl. Environ. Microbiol.*, **43,** 949 (1982).
497. Mowrer, J., *et al.*, "PCB in a Lake Geneva Ecosystem." *Ambio*, **11,** 355 (1982).
498. Westin, D. T., *et al.*, "Effects of Parental and Dietary PCBs on Survival, Growth, and Body Burdens of Larval Striped Bass." *Bull. Environ. Contam. Toxicol.*, **30,** 50 (1983).
499. Sullivan, J. R., *et al.*, "Polychlorinated Biphenyls in the Fish and Sediment of the Lower Fox River, Wisconsin." *Bull. Environ. Contam. Toxicol.*, **30,** 58 (1983).
500. Sloan, R. J., *et al.*, "Temporal Trends Toward Stability of Hudson River PCB Contamination." *Bull. Environ. Contam. Toxicol.*, **31,** 377 (1983).
501. Monod, G., and Keck, G., "PCBs in Lake Geneva (Lake Leman) Fish." *Bull. Environ. Contam. Toxicol.*, **29,** 570 (1982).
502. Schuller, D., and Weppen, P., "Application of Biocalorimetry to the Determination of the Ecotoxicity of Chemicals in Water Ecosystems." *Colorim. Anal. Therm.*, **14,** 264 (1983); *C. A. Selects—Environ. Pollut.*, **21,** 99:117293h (1983).
503. Gooch, J. A., and Hamdy, M. K., "Uptake and Concentration Factor of Aroclor 1254 in Aquatic Organisms." *Bull. Environ. Contam. Toxicol.*, **31,** 445 (1983).
504. Melancon, M. J., and Lech, J. J., "Dose-Effect Relationship for Induction of Hepatic Monooxygenase Activity in Rainbow Trout and Carp by Aroclor 1254." *Aquat. Toxicol.*, **4,** 51 (1983).
505. Shelton, D. W., *et al.*, "Inhibitory Effect of Arochlor 1254 on Aflatoxin-Initiated Carcinogenesis in Rainbow Trout and Mutagenesis Using A *Salmonella*/Trout Hepatic Activation System." *Aquat. Toxicol.*, **3,** 229 (1983).
506. Sodergren, A., and Gelin, C., "Effect of PCBs on the Rate of Carbon-14 Uptake in Phytoplankton Isolates From Oligotrophic and Eutrophic Lakes." *Bull. Environ. Contam. Toxicol.*, **30,** 191 (1983).
507. Millard, E. S., *et al.*, "Polychlorobiphenyl Flux in Planktonic Model Ecosystems. *Arch. Environ. Contam. Toxicol.*, **12,** 203 (1983).
508. Wang, K., *et al.*, "Uptake and Bioaccumulation of Three PCBs by *Chlorella fusca*." *Chemosphere*, **11,** 525 (1982).
509. Larsson, P., "Transport of ^{14}C-Labelled PCB Compounds From Sediment to Water and From Water to Air in Laboratory Model Systems." *Water Res.* (G. B.), **17,** 1317 (1983).
510. Lederman, T. C., and Rhee, G.-Y., "Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture." *Can. J. Fish. Aquat. Sci.*, **39,** 388 (1982).
511. Gotham, I. J., and Rhee, G.-Y., "Effects of Hexachlorobiphenyl

and Pentachlorophenol on Growth and Photosynthesis of Phytoplankton." *J. Great Lakes Res.*, **8,** 328 (1982).

512. McKim, J. M., and Heath, E. M., "Dose Determinations for Waterborne 2,5,2',5'-[^{14}C]Tetrachlorobiphenyl and Related Pharmacokinetics in Two Species of Trout (*Salmo gairdneri* and *Salvelinus fontinalis*): A Mass-Balance Approach." *Toxicol. Appl. Pharmacol.*, **68,** 177 (1983).
513. Waiwood, B. A., and Haya, K., "Levels of Chorionase Activity During Embryonic Development of *Salmo salar* Under Acid Conditions." *Bull. Environ. Contam. Toxicol.*, **30,** 511 (1983).
514. Schindler, D. W., and Turner, M. A., "Biological, Chemical and Physical Responses of Lakes to Experimental Acidification." *Water, Air, Soil Pollut.*, **18,** 259 (1982).
515. France, R. L., "Comment on *Daphnia* Respiration in Low pH Water." *Hydrobiologia* (Den.), **94,** 195 (1982).
516. Eddy, F. B., and Maloiy, G. M. O., "Sodium Balance in the Catfish *Clarias mossambicus* Exposed to Acid Water." *Hydrobiologia* (Den.), **106,** 123 (1983).
517. Zischke, J. A., *et al.*, "Acidification Effects on Macroinvertebrates and Fathead Minnows (*Pimpephales promelas*) in Outdoor Experimental Channels." *Water Res.* (G. B.), **17,** 47 (1983).
518. MacFarlana, R. B., and Livingston, R. J., "Effects of Acidified Water on the Locomotor Behavior of the Gulf Killifish, *Fundulus grandis*: A Time Series Approach." *Arch. Environ. Contam. Toxicol.*, **12,** 163 (1983).
519. Rahel, F. J., "Population Differences in Acid Tolerance Between Yellow Perch, *Perca flavescens*, From Naturally Acidic and Alkaline Lakes." *Can. J. Zool.*, **61,** 147 (1983).
520. McDonald, D. G., "The Effects of H^+ Upon the Gills of Freshwater Fish." *Can. J. Zool.*, **61,** 691 (1983).
521. Havas, M., and Hutchinson, T. C., "Effect of Low pH on the Chemical Composition of Aquatic Invertebrates From Tundra Ponds at the Smoking Hills, N.W.T., Canada." *Can. J. Zool.*, **61,** 241 (1983).
522. Graham, M. S., *et al.*, "The Physiological Responses of the Rainbow Trout to Strenuous Exercise: Interactions of Water Hardness and Environmental Acidity." *Can J. Zool.*, **60,** 3153 (1982).
523. "Acid Precipitation: Effects on Ecological Systems." F. M. D'Itri (Ed.), Ann Arbor Sci., Ann Arbor, Mich. (1982).
524. "Acid Rain/Fisheries." R. E. Johnson (Ed.), Northeastern Div. Am. Fish. Soc., Bethesda, MD (1982).
525. McWilliams, P. G., "An Investigation of the Loss of Bound Calcium From the Gills of the Brown Trout, *Salmo trutta*, in Acid Media." *Comp. Biochem. Physiol., A,* **74,** 116 (1983).
526. Hail, R. J., *et al.*, "Effects of Experimental Acidification on Macroinvertebrate Drift Diversity in a Mountain Stream." *Water, Air, Soil Pollut.*, **18,** 273 (1982).
527. Last, F. T., "Effects of Atmospheric Sulphur Compounds on Natural and Man-Made Terrestrial and Aquatic Ecosystems." *Agric. Environ.*, **7,** 299 (1982).
528. Hock, J., "The Effects of Low pH on Freshwater Fishes" *Fischwirt*, **32,** 9 (1982); *Aquat. Sci. Fish. Abstr.*, **12,** 14539–1Q12 (1982).
529. Fugelli, K., and Vislie, T., "Physiological Response to Acid Water in Brown Trout (*Salmo trutta* L.): Cell Volume Regulation in Heart Ventricle Tissue." *J. Exp. Biol.*, **101,** 71 (1982).
530. McWilliams, P. G., "A Comparison of Physiological Characteristics in Normal and Acid Exposed Populations of the Brown Trout *Salmo trutta*." *Comp. Biochem. Physiol., A,* **3,** 515 (1982).
531. Mathews, J. R., Jr., and Morgan, E. L., "Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park." *J. Environ. Qual.*, **11,** 102 (1982).
532. Hendrey, G. R., "Acid Precipitation Effects on Algal Productivity and Biomass in Adirondack Lakes." PB83-173203, NTIS, U. S. Dept. Commerce, Springfield, VA (1982).
533. Sun, T.-J., and Taylor, D. H., "The Effects of Parathion on Acquisition and Retention of Shuttlebox Avoidance-Conditioning in the Goldfish *Carassius auratus*." *Environ. Pollut.*, **31A,** 119 (1983).
534. Fleming, W. J., *et al.*, "Parathion Accumulation in Cricket Frogs and Its Effect on American Kestrels." *J. Toxicol. Environ. Health*, **10,** 921 (1982).
535. Bisson, P. R., and Bilby, R. E., "Avoidance of Suspended Sediment by Juvenile Coho Salmon." *North. Am. J. Fish. Manage.*, **4,** 371 (1982).
536. Gupta, P. K., and Rao, P. S., "Toxicity of Phenol, Pentachlorophenol and Sodium Pentachlorophenate to a Freshwater Pulmonate Snail *Lymnaea acuminata* (Lamarck)." *Arch. Hydrobiol.* (Ger.), **94,** 210 (1982).
537. Niimi, A. J., and Cho, C. Y., "Laboratory and Field Analysis of Pentachlorophenol (PCP) Accumulation by Salmonids." *Water Res.* (G. B.), **17,** 1791 (1983).
538. Peer, M. M., *et al.*, "Effects of Pentachlorophenol (Na PCP) on Survival, Activity and Metabolism in *Phinomugil corsula* (Hamilton), *Cyprinus carpio* (Linnaeus) and *Tilapia mossambica* (Peters)." *Hydrobiologia* (Den.), **107,** 19 (1983).
539. Gupta, P. K., "Acute Toxicity of Pentachlorophenol to a Freshwater Teleost, *Rasbora daniconius neilgeriensis* (Hamilton)." *Arch. Hydrobiol.* (Ger.), **98,** 127 (1983).
540. Huber, W., *et al.*, "Effects of Pentachlorophenol on the Metabolism of the Aquatic Macrophyte *Lemna minor* L." *Environ. Pollut.*, **29A,** 215 (1982).
541. Robinson-Wilson, E. F., *et al.*, "Effects of Increasing Levels of Primary Production on Pentachlorophenol Residues in Experimental Pond Ecosystems." In: "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), 239, Am. Soc. Test. Mater., Philadelphia, PA (1983).
542. Cleveland, L., *et al.*, "Toxicity of Three Preparations of Pentachlorophenol to Fathead Minnows—A Comparative Study." *Environ. Toxicol. Chem.*, **1,** 205 (1982).
543. Spehar, R. L., *et al.*, "Toxicity of the Synthetic Pyrethroids, Permethrin and AC 222, 705 and Their Accumulation in Early Life Stages of Fathead Minnows and Snails." *Aquat. Toxicol.*, **3,** 171 (1983).
544. Glickman, A. H., and Lech, J. J., "Differential Toxicity of *Trans*-Permethrin in Rainbow Trout and Mice. II. Role of Target Organ Sensitivity." *Toxicol. Appl. Pharmacol.*, **66,** 162 (1982).
545. Friesen, M. K., *et al.*, "Toxicity of the Insecticide Permethrin in Water and Sediment to Nymphs of the Burrowing Mayfly *Hexagenia rigida* (Ephemeroptera: Ephemeridae)." *Can. Entomol.*, **115,** 1007 (1983).
546. Glickman, A. H., *et al.*, "Differential Toxicity of *Trans*-Permethrin in Rainbow Trout and Mice. I. Role of Biotransformation." *Toxicol. Appl. Pharmacol.*, **66,** 153 (1982).
547. Nishiuchi, Y., "Toxicity of Pesticides of Freshwater Organisms. LXXXII. Effects of pH on the Toxicity." *Suisan Zohoku* (Jpn.), 30, 172 (1982); *C.A. Selects—Environ. Pollut.*, **23,** 99:153515r (1983).
548. Nishiuchi, Y., "Toxicity of Pesticides to Freshwater Organisms. LXXXIX. Effects of Water Temperature on the Sensitivity of *Daphnia pulex* to Pesticides." *Suisan Zoshoku* (Jpn.), **30,** 158 (1982); *C.A. Selects—Environ. Pollut.*, **23,** 99:153513p (1983).
549. Nishiuchi, Y., "Toxicity of Pesticides to Freshwater Organisms. LXXX. Differences of the Sensitivity of Two Carp Species to Pesticides." *Suisan Zoshoku* (Jpn.), **30,** 163 (1982); *C.A. Selects—Environ. Pollut.*, **23,** 99:153514q (1983).
550. Nishiuchi, Y., "Toxicity of Formulated Pesticides to Freshwater Organisms. LXXVI." *Suisan Zoshoku* (Jpn.), **30,** 115 (1982); *C.A. Selects—Environ. Pollut.*, **23,** 99:153506p (1983).
551. Nishiuchi, Y., "Toxicity of Pesticides to Some Aquatic Animals. IV. Evaluation of Acute Toxicity of Mixed Formulation of Pesticides to Carp., *Cyprinus carpio* Linne." *Seitai Kagaku* (Jpn.), **5,** 3 (1982); *C.A. Selects—Environ. Pollut.*, **9,** 98:138688k (1983).
552. Rowe, D. W., *et al.*, "Sublethal Effects of Treated Liquid Effluent From a Petroleum Refinery. I. Chronic Toxicity to Flagfish." *Aquat. Toxicol.*, **3,** 149 (1983).

553. Rowe, D. W., *et al.*, "Sublethal Effects of Treated Liquid Effluent From a Petroleum Refinery. II. Growth of Rainbow Trout." *Aquat. Toxicol.*, **3,** 161 (1983).
554. Woodward, D. F., and Riley, R. G., "Petroleum Hydrocarbon Concentrations in a Salmonid Stream Contaminated by Oil Field Discharge Water and Effects on Macrobenthos." *Arch. Environ. Contam. Toxicol.*, **12,** 327 (1983).
555. Nystrom, R. R., and Post, G., Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals." *Bull. Environ. Contam. Toxicol.*, **28,** 271 (1982).
556. Buikema, A. L., Jr., "Variation in Static Acute Toxicity Test Results With *Daphnia magna* Exposed to Refinery Effluents and Reference Toxicants." *Oil Pet. Pollut.*, **1,** 189 (1983).
557. Erben, R., *et al.*, "Effect of Phenol Accumulation on the Survival of Freshwater Snails." *Poljopr. Sumar.*, **28,** 79 (1982); *C.A. Selects—Environ. Pollut.*, **7,** 98:102257e (1983).
558. Gluth, G., and Hanke, W., "The Effect of Temperature on Physiological Changes in Carp, *Cyprinus carpio* L., Induced by Phenol." *Ecotoxicol. Environ. Saf.*, **7,** 373 (1983).
559. Verma, S. R., *et al.*, "Effect of Phenol on *In Vivo* Activity of Tissue Transaminases in the Fish *Notopterus notopterus*." *Ecotoxicol. Environ. Saf.*, **6,** 171 (1982).
560. Erben, R., "The Effect of Phenol and Its Accumulation on Snails *Physa fontinals* and *Radix peregra* Mull. (Pulmonata)." *Period. Biol.*, **84,** 403 (1982); *C.A. Selects—Environ. Pollut.*, **14,** 99:1369h (1983).
561. Nagel, R., "Species Differences, Influence of Dose and Application on Biotransformation of Phenol in Fish." *Xenobiotica*, **13,** 101 (1983).
562. Moorthy, K. S., *et al.*, "Changes in Carbohydrate Metabolism in Tissues of Freshwater Mussel (*Lamellidens marginalis*) Exposed to Phosphamidon." *Bull. Environ. Contam. Toxicol.*, **30,** 219 (1983).
563. Lee, N. E., *et al.*, "Cooling Water Pollutants: Bioaccumulation by *Corbicula*." In: "Water Chlorination: Environmental Impact and Health Effects. Vol. 4, Book 2." R. L. Jolley, *et al.* (Eds.), Ann Arbor Sci., Ann Arbor, Mich., 851 (1983).
564. Goodfellow, W. L., Jr., *et al.*, "Effect of Picric and Picramic Acids on Growth of Rainbow Trout (*Salmo gairdneri*) and American Oysters (*Crassostrea virginica*)." *Chemosphere*, **12,** 1259 (1983).
565. Call, D. J., *et al.*, "Toxicity, Bioconcentration, and Metabolism of the Herbicide Propanil (3',4'-Dichloropropionanilide) in Freshwater Fish." *Arch. Environ. Contam. Toxicol.*, **12,** 175 (1983).
566. Taernholm, A., *et al.*, "Effect of Bleaching Plant Effluent on Propagation and Early Development in Fish. 10. Effect on Propagation in Zebra Fish of the Total Bleaching Effluent From Production of C/DEHDED and D/C(E + O)DED Bleached Coniferous Sulfate Pulp." *Inst. Vatten-Luftvaardsforsk. B*, **691** (1982); *C.A. Selects—Environ. Pollut.*, **1,** 98:1276e (1983).
567. Oikari, A. O. J., and Nakari, T., "Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout." *Bull. Environ. Contam. Toxicol.*, **28,** 266 (1982).
568. Wagner, J., "Removal of Colour, COD and Toxicity From Kraft Bleach Effluent." *Appita*, **36,** 52 (1982).
569. Berg, N., "Chemical and Sensory Analysis of Off-Flavours in Fish From Polluted Rivers in Norway." *Water Sci. Technol.*, **15,** 59 (1983).
570. Eloranta, V., and Laitinen, O., "The Usefulness of the *Selenastrum capricornutum* Algal Assay to Evaluate the Toxic Effects of Pulp and Paper Mill Effluents in Lake Water. Algal Assays on Recipient Waters of Some Pulp and Paper Mills in Central Finland." *Vatten* (Swed.), **38,** 317 (1982).
571. Hendry, G. S., *et al.*, "Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River." *Water Res.* (G. B.), **16,** 1291 (1982).
572. Lin, Y. M., and Chang, P. S., "Radiation Effects on Aquatic Organisms." *Yuan Tzu Neng Wei Yuan Hui Hui Pao* (China), **18,** 51 (1982); *C.A. Selects—Environ. Pollut.*, **7,** 98:103514y (1983).
573. Egami, N., *et al.*, "Dominant Lethal Mutation Rate After γ-Irradiation of the Fish, *Oryzias latipes*." *Mutat. Res.*, **107,** 265 (1983).
574. Piskunov, L. I., *et al.*, "Assessment of Artificial Radionuclide Content and Internal β-Radiation Doses in Roach, *Rutilus rutilus*, and Bream, *Abramis brama* (Cyprinidae), of Different Age." *J. Ichthyol. (Engl. Trans.)*, **22,** 121 (1982).
575. Nikinmaa, M., and Oikari, A. O. J., "Physiological Changes in Trout (*Salmo gairdneri*) During a Short-Term Exposure to Resin Acids and During Recovery." *Toxicol. Lett.*, **14,** 103 (1982).
576. Chandler, J. H., Jr., "Toxicity of Rotenone to Select Aquatic Invertebrates and Frog Larvae." *Prog. Fish Cult.*, **44,** 78 (1982).
577. Burress, R. M., "Effects of Synergized Rotenone on Nontarget Organisms in Ponds." Invest. Fish Control 91, Fish. Wildl. Serv., U. S. Dept. Interior, Warm Springs, Ga. (1982).
578. Couillard, D., "Toxicity Assessment of Snowmelt Water Runoff in an Urban Area." *Water Res.* (G. B.), **16,** 1197 (1982). In French.
579. Sullivan, J. F., "Impact of snowmelt-runoff from agricultural watersheds on dissolved oxygen." *J. Water Pollut. Control Fed.*, **55,** 170 (1983).
580. Medeiros, C., *et al.*, "An *In Situ* Assessment of the Acute Toxicity of Urban Runoff to Benthic Macroinvertebrates." *Environ. Toxicol. Chem.*, **2,** 119 (1983).
581. Medeiros, C., and Coler, R. A., "A Laboratory/Field Investigation Into the Biological Effects of Urban Runoff." PB83–177956, NTIS, U. S. Dep. Commerce, Springfield, Va. (1982).
582. Chervinski, J., "Salinity Tolerance of the Mosquito Fish, *Gambusia affinis* (Baird and Girard)." *J. Fish Biol.*, **22,** 9 (1983).
583. Sorensen, E. M. B., and Bauer, T. L., "Hematological Dyscrasia in Teleosts Chronically Exposed to Selenium-Laden Effluent." *Arch. Environ. Contam. Toxicol.*, **12,** 135 (1983).
584. Hodson, P. V., and Hilton, J. W., "The Nutritional Requirements and Toxicity to Fish of Dietary and Waterborne Selenium." *Ecol. Bull.*, **35,** 335 (1983).
585. Lemly, A. D., "A Simple Activity Quotient for Detecting Pollution-Induced Stress in Fishes." *Environ. Technol. Lett.*, **4,** 173 (1983).
586. Reading, J. T., and Buikema, A. L., Jr., "Chronic Effects of Selenite-Selenium on *Daphnia pulex*. *Arch. Environ. Contam. Toxicol.*, **12,** 399 (1983).
587. Lawrence, S. G., and Holoka, M. H., "Effect of Selenium on Impounded Zooplankton in a Mercury Contaminated Lake." *Can. Tech. Rep. Fish. Aquat. Sci.*, **1151,** 83 (1983).
588. Ding, S., *et al.*, "Acute Toxicity of Silver to Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*) and Its Accumulation and Distribution in Fish Bodies." *Huanjing Kexue* (China), **3,** 6 (1982); *C.A. Selects—Environ. Pollut.*, **24,** 97:176355m (1982).
589. Nebeker, A. V., *et al.*, "Toxicity of Silver to Steelhead and Rainbow Trout, Fathead Minnows and *Daphnia magna*" *Environ. Toxicol. Chem.*, **2,** 95 (1983).
590. Goldsborough, L. G., and Robinson, G. G. C., "The Effect of Two Triazine Herbicides on the Productivity of Freshwater Marsh Periphyton." *Aquat. Toxicol.*, **4,** 95 (1983).
591. Hawkins, W. E., *et al.*, "Histological Effects of Space Shuttle Launch Toxicants of Fishes." *Fla. Sci.*, **46,** 18 (1983); *Sports Fish. Abstr.*, **28,** 83-001195 (1983).
592. Haswell, M. S., *et al.*, "Millimolar Quantities of Sodium Salts Used as Prophylaxis During Fish Hauling." *Prog. Fish Cult.*, **44,** 179 (1982).
593. Kindig, A. C., *et al.*, "Differential Sensitivity of New Versus Mature Synthetic Microcosms to Streptomycin Sulfate Treatment." In "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 192 (1983).
594. Bouck, G. R., and King, R. E., "Tolerance to Gas Supersaturation in Fresh Water and Sea Water by Steelhead Trout, *Salmo gairdneri* Richardson." *J. Fish Biol.*, **23,** 293 (1983).

595. Gray, R. H., and Page, T. L., "Tolerance of Carp *Cyprinus carpio* and Black Bullhead *Ictalurus melas* to Gas-Supersaturated Water Under Lotic and Lentic Conditions." *Environ. Pollut.*, **30A,** 125 (1983).

596. Lewis, M. A., and Suprenant, D., "Comparative Acute Toxicities of Surfactants to Aquatic Invertebrates." *Ecotoxicol. Environ. Saf.*, **7,** 313 (1983).

597. Nishiuchi, Y., "Toxicity of Pesticides to Some Aquatic Animals. III. Toxicity of Several Surface Active Agents to *Oryzias latipes, Daphnia carinata* and Tadpole of *Bufo bufo japonicus*." *Seitai Kagaku* (Jap.), **37** (1982); *C.A. Selects—Environ. Pollut.*, **21,** 97:121639b (1982).

598. Ernst, R., *et al.*, "Biological Effects of Surfactants: Part 6—Effects of Anionic, Non-Ionic and Amphoteric Surfactants on a Green Alga (*Chlamydomonas*)." *Environ. Pollut.*, **31A,** 159 (1983).

599. Bluzat, R., and Seuge, J., "Chronic Intoxication by an Herbicide, 2,4,5-Trichlorophenoxyacetic Acid, in the Pond Snail, *Lymnaea stagnalis l.*" *Environ. Res.* **31,** 440 (1983).

600. Frost, S., and Sinniah, L. B., "Effect of Particulate Abate Insecticide on Invertebrate Stream Drift Communities in Newfoundland." *Int. J. Environ. Stud.*, **19,** 231 (1982).

601. Kpekata, A. E., "Acute Toxicity of O,O'-(Thio-di-4,1-phenylene) bis(O,O-dimethyl phosphorothioate) (Temephos) to *Lebistes reticulatus* and *Sarotherodon galilaea*." *Bull. Environ. Contam. Toxicol.*, **31,** 120 (1983).

602. Helder, T., "Effects of TCDD on Early Life Stages of Fresh Water Fish." In: "Environment and Quality of Life. Principles for the Interpretation of the Results of Testing Procedures in Ecotoxicology." EUR 7549, Comm. Eur. Commun., Luxembourg, Belgium (1982).

603. Pickering, Q. H., "Chronic Toxicity to Fathead Minnow *Pimephales promelas* of Wastewater From a Conventional Wastewater Treatment System Receiving Organic Priority Pollutants." *Environ. Pollut.*, **31A,** 105 (1983).

604. Corbet, R. L., *et al.*, "Fate of 1,3,6,8-T_4 CDD in an Outdoor Aquatic Systems." *Chemosphere,* **12,** 523 (1983).

605. O'Keefe, P., *et al.*, "Analysis of 2,3,7,8-Tetrachlorodibenzo-p-dioxin in Great Lakes Fish." *Chemosphere,* **12,** 325 (1983).

606. Rao, K. S., *et al.*, "Changes in Nitrogen Metabolism in Tissues of Fish (*Sarotherodon mossambicus*) Exposed to Benthiocarb." *Bull. Environ. Contam. Toxicol.*, **30,** 473 (1983).

607. Watanabe, S., *et al.*, "Investigation on the Contamination of Freshwater Fish With Herbicides (CNP, Chlomethoxynil, Benthiocarb and Molinate)." *J. Pestic. Sci.*, **8,** 47 (1983).

608. Buckley, J. A., "Complexation of Copper in the Effluent of a Sewage Treatment Plant and an Estimate of Its Influence on Toxicity to Coho Salmon." *Water Res.* (G. B.), **17,** 1929 (1983).

609. Ali, A., and Stanley, B. H., "Effects of a New Carbamate Insecticide, Larvin (UC-51762), on Some Nontarget Aquatic Invertebrates." *Fla. Entomol.*, **65,** 477 (1982).

610. Seuge, J., and Bluzat, R., "Acute Toxicity of a Dithiocarbamate Fungicide Thiram in Larvae of the Mayfly *Cloeon dipterum* Effects of Various Parameters." *Hydrobiologia* (Den.), **101,** 215 (1983).

611. Bluzat, R., *et al.*, "Acute Toxicity of a Fungicide, Thiram (Dithiocarbamate), to the Freshwater Mollusk *Lymnaea stagnalis*." *Colloq.-Inst. Natl. Sante Rech. Med.* (Fr.), **106,** 377 (1982); *C.A. Selects—Environ. Pollut.*, **7,** 98:102347j (1983).

612. Filenko, O. F., and Parina, O. V., "Distribution of 3-Alkil Tin Chlorides Among the Organs as a Factor Determining Their Toxicity for Carps." *Biol. Nauki* (USSR), **4,** 54 (1982); *Aquat. Sci. Fish. Abstr.*, **12,** 14486-1Q12 (1982).

613. Wong, P. T. S., *et al.*, "Structure-Toxicity Relationship of Tin Compounds on Algae." *Can. J. Fish. Aquat. Sci.*, **39,** 483 (1982).

614. Devlin, E. W., "Developmental Studies on the Fathead Minnow (*Pimephales promelas* Raf.): I. The Prehatching Development of the Fathead Minnow. II. The Acute Effects of Toluene on Three Age Groups of Fathead Minnows. III. The Effect of Toluene on the Prehatching Development of the Fathead Minnow." *Diss. Abstr. Int. B,* **43,** 3502 (1983).

615. Huckins, J. N., and Petty, J. D., "Dynamics of Isopropylphenyl Diphenyl Phosphate in Fathead Minnows." *Chemosphere,* **12,** 799 (1983).

616. Wells, D. E., and Cowan, A. A., "Vertebral Dysplasia in Salmonids Caused by the Herbicide Trifluralin." *Environ. Pollut.*, **29A,** 249 (1982).

617. Palawski, D., *et al.*, "Survival and Condition of Rainbow Trout (*Salmo gairdneri*) After Acute Exposures to Methyl Parathion, Triphenyl Phosphate, and DEF." *Bull. Environ. Contam. Toxicol.*, **30,** 614 (1983).

618. Mahon, C. D., and Mathewes, R. W., "Seasonal Variation in the Accumulation of Radionuclides of the Uranium Series by Yellow Pond-Lily (*Nuphar lutea*)." *Bull. Environ. Contam. Toxicol.*, **30,** 575 (1983).

619. Pandy, K., and Shukla, J. P., "Acute Toxicity of Carbamide and Its Long Term Effects on the Growth of Fingerlings of a Tropical Fresh Water Teleost, *Colisa fasciatus* (Bloch & Sch.)." *Acta Hydrochim. Hydrobiol.*, **11,** 145 (1983).

620. Holdway, D. A., *et al.*, "Bioconcentration of Vanadium in American Flagfish Over One Reproductive Cycle." *Water Res.* (G. B.), **17,** 937 (1983).

621. Clark, E. R., and Fraser, J. A. L., "The Survival and Growth of Six Species of Freshwater Fish, in Tapwater and Diluted and Undiluted Effluent From Sewage Percolating Filters." *J. Fish Biol.*, **22,** 431 (1983).

622. Grizzle, J. M., and Melius P., "Causes of Papillomas on Fish Living in Chlorinated Sewage Effluent." PB83-111039, NTIS, U. S. Dept. Commerce, Springfield, Va. (1982).

623. Stevenson, R. J., and Stoermer, E. F., "Abundance Patterns of Diatoms on *Cladophora* in Lake Huron With Respect to a Point Source of Wastewater Treatment Plant Effluent." *J. Great Lakes Res.*, **8,** 184 (1982).

624. Suckling, D. M., "Organic Wastewater Effects on Benthic Invertebrates in the Manawatu River." *N. Z. J. Mar. Freshwater Res.*, **16,** 263 (1982).

625. Keefe, D. F., *et al.*, "Field Investigations and On-Site Toxicity Testing: An Assessment of Habitat Suitability—Arkansas River, Pueblo, Colorado." In: "Aquatic Toxicology and Hazard Assessment: Sixth Symposium." ASTM STP 802, W. E. Bishop, *et al.* (Eds.), Am. Soc. Test. Mater., Philadelphia, Pa., 216 (1983).